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99'er HOME COMPUTER magazine

April, 1983 $3.50 in U.S.A.

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Word World For Kids

Fun With Sprites

The Philosophy of
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[illegible] Money With The Home Computer

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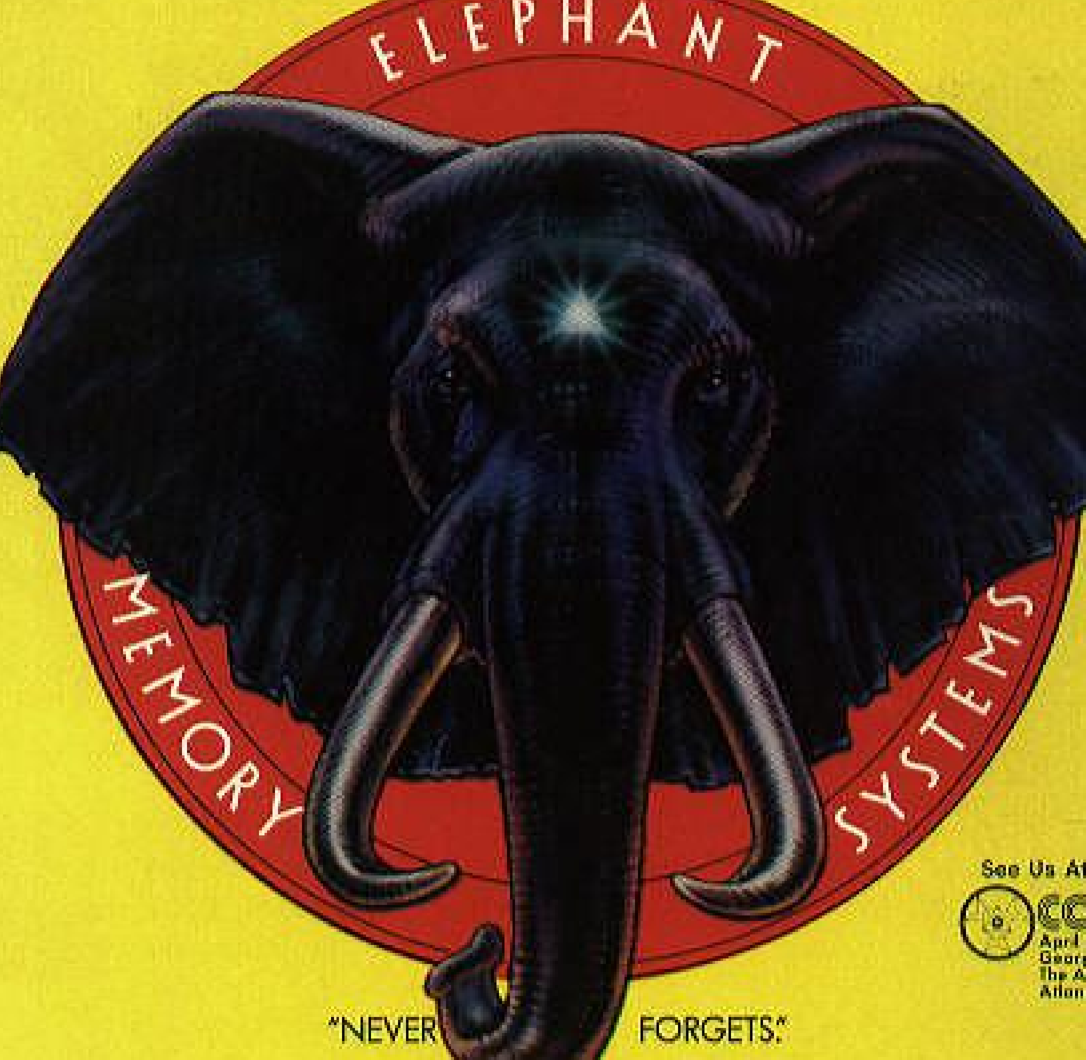

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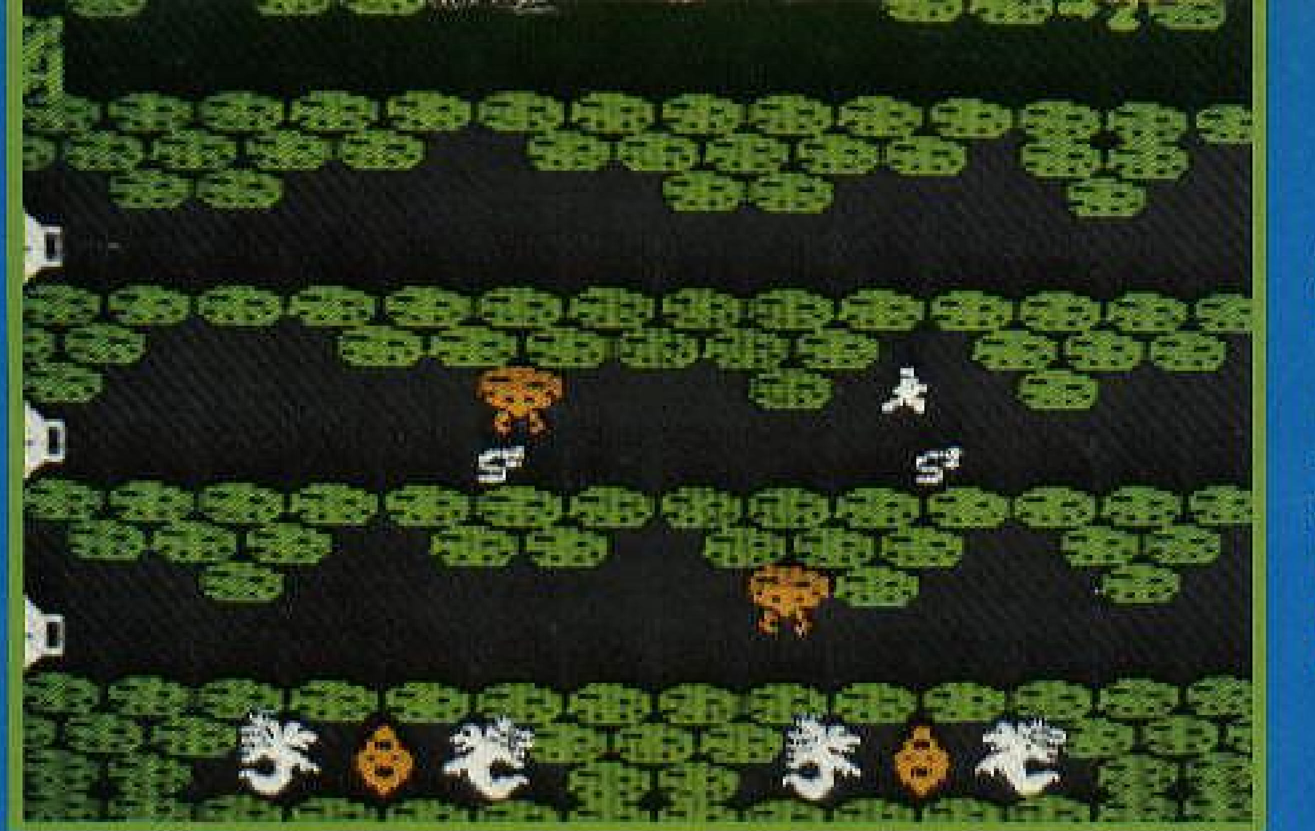

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ON SCREEN

By Gary M. Kaplan
Publisher & Editor-in-Chief

> "Not taking advantage of the many home finance programs that are available for your Home Computer is like hiring Julia Child as your chef and asking her to heat up canned beef stew every night . . ."

Madison Avenue is forever bombarding us with expensive products that will supposedly lead to "big savings." A ten-thousand-dollar car that will save dollars at the gas pump; a rustic woodstove that will cut your heating bill in half; a high-priced "home entertainment center" to keep you from blowing your whole month's salary at the movies. It is no wonder that the average consumer might be a bit skeptical when the same claim is made by personal computer manufacturers. Even present Home Computer owners might question whether their system has even partially paid for itself. True, Junior spends a lot more time at home playing *Parsec* instead of dropping Mom and Dad's hard-earned quarters at the neighborhood arcade, but that barely justifies the cost of a joystick, let alone the whole system.

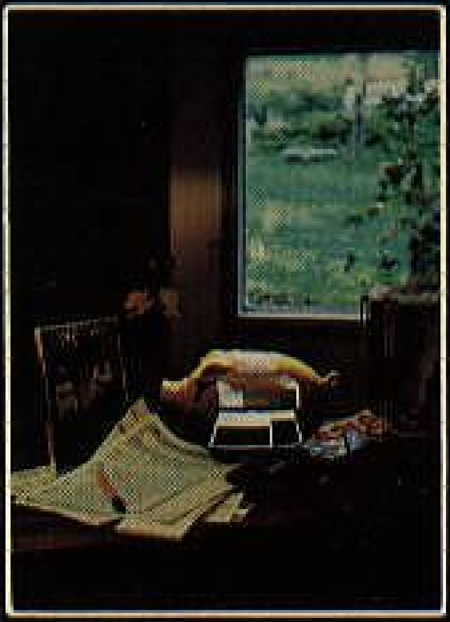
What *were* all those home management and personal finance applications that tripped off your tongue when you were justifying your computer system to dubious friends? As is the case with any new technology, many Home Computer owners are simply unaware of many of the functions their systems can perform. Financial and home management applications are a case in point: Not taking advantage of the many home finance programs that are available for your Home Computer is like hiring Julia Child as your chef and asking her to heat up canned beef stew every night. You are not only wasting a valuable resource, you might also be wasting your money!

When used to its maximum effectiveness, the Home Computer can indeed save you money, and not just in terms of saving time. Recently, I heard of a case in which a Home Computer owner used TI's *Personal Real Estate* cartridge to analyze all the facts concerning a piece of real estate he was about to buy. Although he was fairly knowledgeable in the field, he found that after checking the computer analysis, the wisest thing to do was back out of escrow. The cartridge showed a potential $4000 loss!

The computer can't make important financial decisions *for* you, but it can analyze the data, keep track of all the records, and make dispassionate comparisons. The software available from TI already covers the home finance gamut—from balancing your checkbook, to securities analysis. The *Household Budget Management* program, for example, will set budget guidelines, track income and expenses, spot problem areas, and keep easily accessible records. It can also provide *instant* graphic analyses and tables, and coordinate your income and expenses for the coming year, month by month and category by category.

Once you have analyzed your budget, you can use a *Home Financial Decisions* cartridge to make informed decisions on such matters as loans, home and car buying, and personal savings. It will also clarify the actual costs of leasing versus buying. There is also a *Personal Financial Aids* package which offers financial statement development, programs on loan amortization schedules, depreciation computations, and mortgage analysis. A *Household Inventory* program allows you to build and maintain an up-to-date list of household inventory items. It will calculate actual replacement value (based on purchase dates and previous year's price indices), and can also be tailored for specific collectibles. Finally, a *Tax Investment Record Keeping* cartridge will organize your tax and investment data. And if there's money left over, a *Securities Analysis* cartridge provides such investment decision-making tools as stock analysis, call options, option spreads, bond analysis, and calculations of compound interest, annuities and variable cash flow.

We are, however, barely scratching the surface with these examples of home finance programs from Texas Instruments. There is also a good supply of comparable third-party software from our advertisers, plus the finance-related, type-in-and-RUN program listings we present to you in this and other issues of the magazine. But beyond the available software and money-saving ideas in this month's issue, there remains a largely untapped potential. Unlike the so called "economy" car or stereo, the Home Computer is a tool with *unlimited* money-saving applications. Picture a meticulous accountant whose memory and arithmetic are always correct. Or a conservative banker who insists on comparing the costs for any purchase over $100. As a silent financial partner, your Home Computer can perform these tasks and more. And then, what will your duties as the *active* partner be? You will still be needed to supply the intangibles—the "business hunch" and creative ideas—and of course, to eventually *spend* all of the money you've so scrupulously saved.



99'er HOME COMPUTER magazine

The cover artwork by Hayder Amir depicts the complexities of personal finances—an especially confusing topic at tax time. Many readers may identify with the associations in this picture: As we attempt to manage our money and cope with government paperwork, the major incentive to "make it" gazes at us from the family photos. Meanwhile, the spring greenery outside the window reminds us that we may have better things to do on such a fine day. There is hope, however, in the little machine whose image fills the piggy bank on the table. Chances are our TI-99/4A user will not only straighten out those financial problems in time to make it to this afternoon's baseball game, but also save money in the process.

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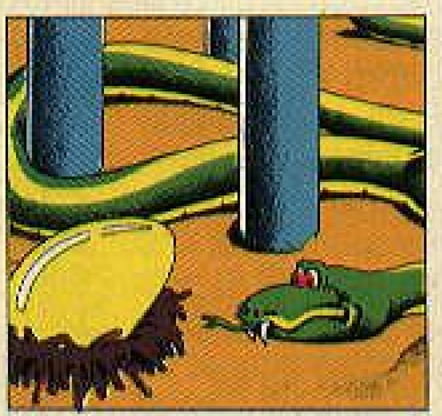

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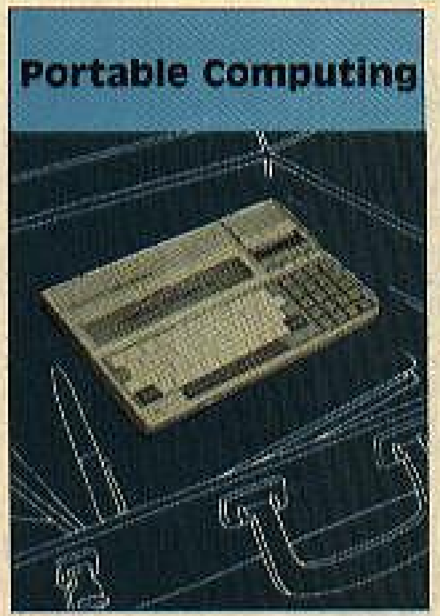

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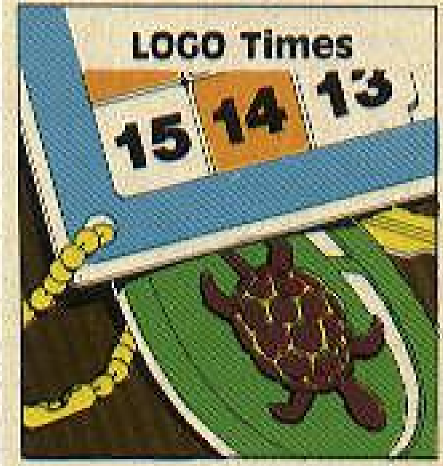

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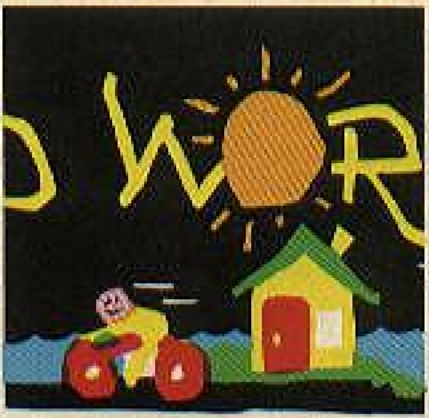

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INSIDE 99'er

Money . . . some say it talks and makes the world go 'round; others claim it is the "root of all evil." No matter how we feel about money, it tends to occupy our minds during the month of April. If this month finds you contemplating 1040 schedules instead of spring flowers, outdoor barbecues or romance, you may be in need of some Home Computer-assisted financial management.

There is help on the way with this month's launching of a new regular feature, *Multiplan Medium*. The *Multiplan* software package generates "spread sheets"—such as accountants use—to help you plan your budget, make detailed financial forecasts, and figure all the angles in complex money decisions. The range of applications is endless. In the issues that follow, we will explain how *Multiplan* can help you find your way through the maze of confusing financial figures and maybe even save you some money.

And if you're really serious about saving money, the strategies offered in *Porsches and Other Pipe Dreams* will provide valuable information on building a nest egg, and determining which savings plan is right for you. After all, a savings account is the first step in building a firm financial base.

If *your* financial foundation is a bit shaky, you might benefit from the ideas in *Coping with Coupons*. Claiming that coupons can help you cut over 23% from your food costs, this article provides a program for organizing your coupons to trim your budget.

Planning your food budget may leave you hungry for some lighthearted diversion. If that is the case, you will want to try your hand at *Boa Alley*. The ravenous reptile in this game has a simple goal: to gobble eggs and avoid entanglements as he slithers through the dark world beneath your home's foundation.

Coming out of the darkness, we find the bright, colorful images of *Word World*. Designed for young children, this program graphically displays the pictures of objects as they are typed out on the keyboard. And speaking of graphic demonstrations, *Programming Sprites in Mini Memory* explains, in detail, a program that uses the Mini Memory Command Cartridge to manipulate sprites.

Manipulating the numbered tiles is the object of *Fifteen*, a game in this month's LOGO Times section. You'll enjoy the hours you spend putting these squares into their proper order.

Bringing order to the gibberish of a secret code is a task for an expert cryptographer. You can create and decipher your own unintelligible code, however, with *Tex-Cipher*. Think of all the uses you could have for a secret language, understood by only your select group. . .

Users groups, on the other hand, are open to anyone with an interest in computers. A new feature—*Group Grapevine*—will print items of interest sent in by users groups throughout the world. If you would like to publicize your group's activities, send in a group newsletter for consideration in this column. We are eager to hear from groups both large and small.

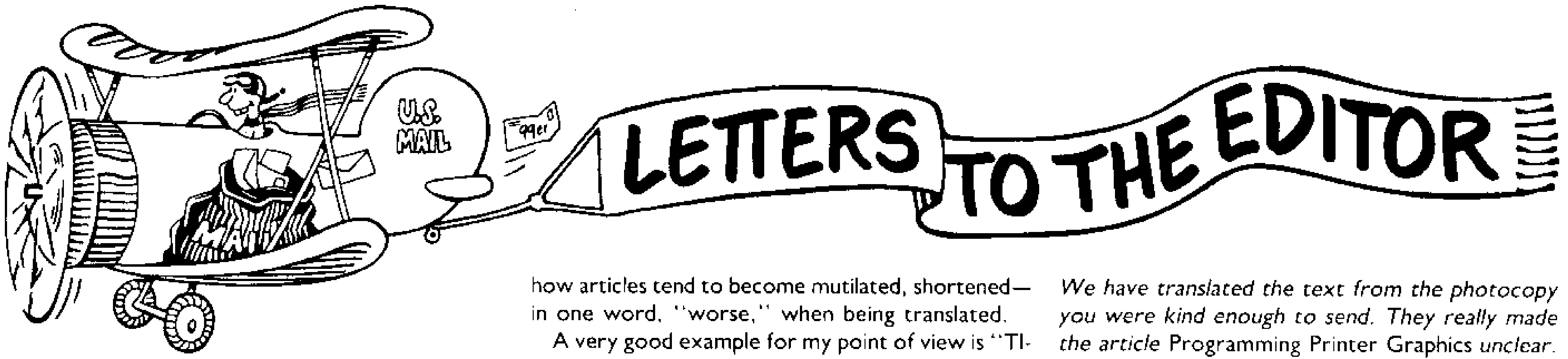
Giant and Dwarfs, one of this month's game offerings, provides a twist on the usual fairy tale. This time it is the giant who is being tormented by a pack of evil dwarfs. These malevolent munchkins are ganging up on the gentle giant, trying to trap him in a cage. You have the option of playing either dwarf or giant.

The development of a dwarf-sized computer with giant capabilities is covered in the *Interview With Herb Shanzer*. The manager of TI's Calculator and Compact Computer Division explains what went into the decision to build the new Compact Computer.

Another new computer, the TI-99/2, is the focus of *Big Machine on Campus*. This article describes how the 99/2 could become a dormitory room fixture, providing the computer experience college students are so avidly seeking.

And the other features 99'er readers avidly seek every month—such as reviews, helpful hints, games, and news—complete our April excursion through the world of TI-99/4A Home Computing.

Until next month, have fun reading, learning and RUNing!



LETTERS TO THE EDITOR

Dear Sir:

I am a new subscriber to 99'er Magazine and I have enjoyed the few issues I have. Your magazine has helped me so much with my programming.

An interesting note for *Munch Man* owners: *Munch Man* has, hidden away in its program, a Test Mode. This gives you the ability to chose any round (1-20, 21-40, 41-60), and screen (1-20), and up to nine Munch Men. To enter the Test Mode, just press within three seconds when the (Munch Man) title screen appears:

SHIFT 8,3,8, or "#"

After this is done, RND(0 – 2) (what round) will appear. When you've chosen what round you want, SCN(0-19) (WHAT SCREEN) will appear. Then MM(1-9) (how many Munch Men).

NOTE: Remember 0 is 1!

I hope this information is helpful to *Munch Man* users.

P.S. Do you think you could have a TI Fest in the New York area?

Tony Cappo
Danbury Ct.

For those of you who read Designer's Spotlight *in the January Issue of 99'er Home Computer Magazine, Tony is talking about the "debugger" feature of Munch Man.*

Regarding the site of the next TI-Fest, New York is being considered—along with other major metropolitan areas. As soon as details are worked out, they will be published in the magazine.

Dear Sir:

In the editorial of your January 1983 issue, you said that you want to publish foreign issues of your fine magazine later in the year. I wish you good luck with your plans, but I hope you don't mind if I keep subscribing to the "original."

After comparing Weider's *Muscle & Fitness* to its German edition *Sport-Revue* for some time, I know how articles tend to become mutilated, shortened—in one word, "worse," when being translated.

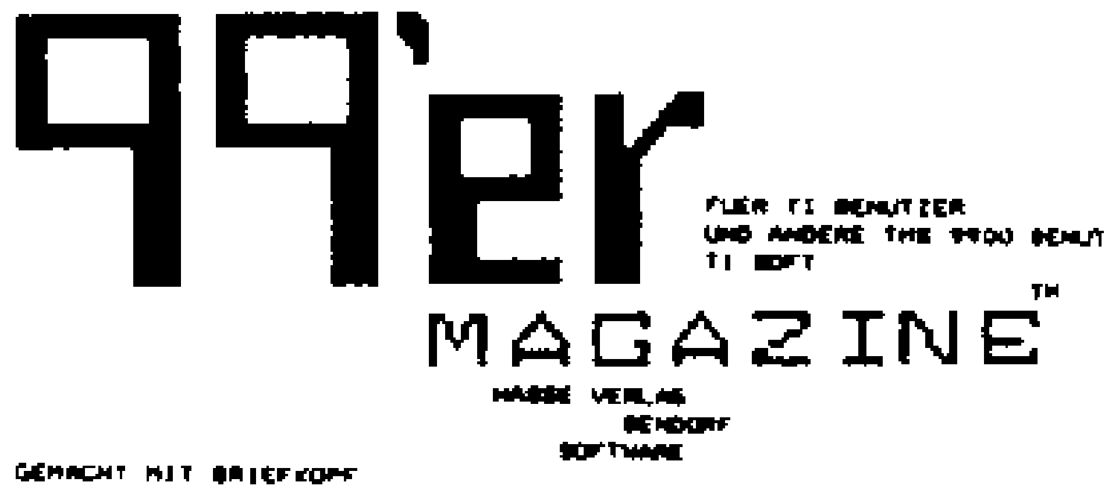
A very good example for my point of view is "TI-Magazin" which currently reprints your articles and programs in German. I mean, have you ever bothered to reread your articles after "TI-Magazin" translated them? If not, you may study the enclosed photo-copies in depth. A whole lot of information was lost in the translation of "99'er Letterhead." [Refers to the *Programming Printer Graphics* article that appeared in the *99'er* May/June 1981 issue.—Ed.]

Furthermore I don't quite see the point in renaming one of the few peaceful games you published, "Muir Woods" from "San Francisco Tourist" into "Minenraumkomando" (= Mine-Removal-Detachment), or "Crookedest Street" from the same program into "Ford Rallye-Teststrecke." Is Ford a sponsor of your "TI-Magazin?"

I would never have subscribed to "TI-Magazin" if I had seen one copy before; but as it is, I will cancel my German subscription as soon as possible and will forever be subscribing to the American edition.

For all my German fellow 99'ers I sincerely hope that your *new* German magazine (you do plan a *real* German edition, don't you?) will be better than the kind of magazine the current German publisher "Hasse Verlag, Raabestr. 5, 5413 Bendorf 1" is putting out.

Ulrich Lobjinski
Lenaustr. 67a
6000 Frankfurt/Main 1



As you undoubtedly surmised, Ulrich, "Hasse Verlag" is publishing a totally unauthorized German version of articles from 99'er Magazine. They have changed some of the text and part of the programs. We have translated the text from the photocopy you were kind enough to send. They really made the article Programming Printer Graphics *unclear. When the author (W.K. Balthrop) was shown the listing of the program that prints the letterhead, he immediately recognized it. "Hasse Verlag" had removed the original credit, "REM" statements, substituted their company name for ours, and had not even resequenced the listing! He keyed in the program from their listing and ran it. The results have been reduced and printed above.*

Let me assure you that action is being taken in this matter of blatent copyright violation. We have been in contact with legitimate German publishers and plan to move quickly to produce a quality translation of the real 99'er Home Computer Magazine.

Dear Sir:

I am one of the poor little 99 users whom TI forgot. That is to say, a British (Scottish, actually) owner of a TI-99/4A Home Computer. I have had it for well over a year and in all that time I have been searching relentlessly for software and hardware peripherals to back up my excellent American computer. Can I find any? I can not! And why? We have been given every conceivable excuse by TI's British representatives but my guess is that either TI does not think it worthwhile to supply the British market or—more likely—someone, somewhere is too tired to get off their duffs—I believe you say 'butts' and organize the exports.

Everything here is in very short supply. Extended BASIC; RS232 and Mini-Memory peripherals; TI-Writers; Printers—nothing can be had for love nor money. Even your excellent magazine, sir, is worth its weight in gold! When I thumb through its advertisement-filled pages, sir, I drool. Just imagine! All ancillary equipment just for the asking!

And so to the point of my letter. If some of your enterprising advertisers would care to direct their advertisements at the British market as well as the American, I feel sure they would find rich pickings. The kind of things I have in mind is, if they could

Continued

Entering 99'er Programs

New readers should be aware that within the magazine's pages are found actual computer programs that *you* can put into your Home Computer and enjoy.

Make sure you have any special system components required by the program (i.e., the Speech Synthesizer, Extended BASIC cartridge, etc.). Then, using the console keyboard, you can type the printed magazine listing (character for character, and line by line) into the computer's memory.

Before entering the program, connect a cassette recorder to the computer. Make sure you have two blank cassette tapes. For each 10-20 lines you type in, use SAVE CS1 to save that program segment onto one of the tapes. Alternate between the two tapes each time you save the program. Be sure to rewind to the beginning of each tape before saving, so that you always record over and replace the shorter segment of program lines with the longer segment. By following this procedure, you'll always retain most of your work even if the lights go out or someone turns off the computer.

Double check your typing against the program listing for errors, and *then* have someone else check it. The most common errors are typing the letter "O" instead of the number "0" (zero)—they are *not* interchangeable to the computer. This is also true for the letters "l" and "L" and number "1" (one). [See "Key-In Reference"

Every time you make a correction to your program, SAVE CS1 and switch the tapes. Once all the errors are corrected, you will have a good copy of the program on the last tape. Before turning off the computer, put the other cassette tape in your recorder and once again SAVE CS1. Now, if one tape gets damaged, you won't have to enter the program listing via the keyboard all over again. Have fun and happy computing. 99'er

Programming Conventions

KEY-IN REFERENCE

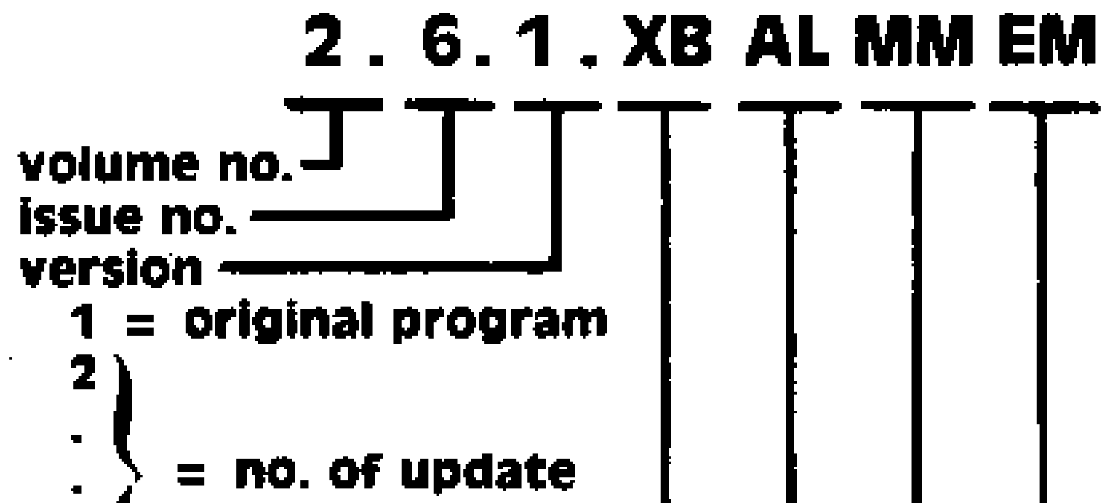
```
100 ABCDEFGHIJKLMNOPQRSTUVWXYZ+) (*
&^%$#@!-/:;>.<,"'?_][~|{}\`012
3456789
```

99'er =End of Program or Article

compu-prestidigitation

(kóm·pū·prĕś·teh·dĭ·jeh·tā́·shŭn) —*n.* **1.** The magical quality of unexpected comprehension that results from presenting technical information about computers in a lively, entertaining, visually attractive and easy-to-understand format. **2.** The magical tricks that make a computer sing, dance, and do all sorts of wonderfully useful things.

99'ER VERSION



GROUP GRAPEVINE

Group Grapevine: News of TI Users Groups From Around the World.

The Users Group of Orange County is considering an on-going Short Program contest. They are also promoting an equipment swap at their regular meetings, held every third Thursday at the Santa Ana, (CA) Library. President of UGOC is **Arnie Hirsh**, 1673 W. Chateau, Anaheim, CA 92802, tel. (714) 774-3076.

According to a poll taken by the **Kentuckiana 99/4 Computer Society** (9801 Tiverton Way, Louisville, KY 40222, tel. (502) 425-4959), the most popular cartridges among society members were *Parsec, Munch Man, Extended BASIC, TI Invaders*, and *Terminal Emulator II*, in that order. This group is also forming a Youth Division in order to promote family involvement with the computer. **John Tucker**, of the group's Ham Division, reports that a Ham Group in **Chicago** operates every Tuesday at 9:00 (CST), Echo Repeater 145.27 MHz out, 114.67 in (Voice Net), 2 Meter FM. Readers may wish to listen in and possibly find out what this group is up to.

The **JSC (Johnson Space Center) Users Group (JUG)** likes to trade newsletters and software with other groups. Write **Mike Matula**, JSC Users Group, 15918 Cavendish Dr., Houston, TX 77059, tel. (713) 486-0224. At this group's March meeting, TI's new *Professional Computer*, code-named "Pegasus," was demonstrated by **Tom Dasenbrock** of the Pegasus design team, who is also a member of the **Houston User's Group (HUG)**.

Roger Harrison of the **New Jersey Users Group** reports that this new club is using a detailed questionnaire in order to ask its members which direction they'd like to take. The group meets every second Monday of the month at the Iselin Public Library. Newsletter editor is **Stephen Citron**, 386 White Oak Ridge Rd., Short Hills, NJ 07078.

The **Central Ohio TI Users Group**'s president, **Pat Saturn**, has invented a hard plexiglass keyboard cover, because his cat has found Function Quit on the TI-99/4A. Pat also edits the group's newsletter, *Spirit of 99*, 1456 Grandview Ave., Columbus, OH 43212, tel. (614) 468-7262.

After each meeting of the **TI-99/4 Pittsburgh Users Group** (Box 18124, Pittsburgh, PA 15236), members form three discussion groups: one for beginners, another for those who are planning a specific project, and a third group for people interested in Assembly Language.

The **Cin-Day Users Group**, P. O. Box 519, West Chester, OH 45069, tel. (513) 777-0110, is getting so large, (230 members) it must constantly seek new meeting places. A recent meeting featured demonstrations of *Tunnels of Doom* and *Multiplan*.

The new **San Gabriel Valley 99 Series Users Group** (1008 Dore St., West Covina, CA 91792) has just published the first number of its newsletter, expertly edited by **Cheryl Young**. At its first meeting, the group took in a demonstration by **Craig Miller**, who provided software for the door prize. The group is actively seeking input and can be reached through President **Tom Padilla** at the above address, or tel. (213) 330-8240.

quote their prices in real mon . . . sorry, Sterling . . . as well as Dollars it would be real help. Also, perhaps they could present us with some sort of 'package' which would make the importation easier.

You know, sir, we do so want to be members of the 99'er family over here, but we do feel very 'left out'.

John "Jack" Cunningham McKillop
Glasgow
Scotland, U.K.

Jack, we hear your plea and understand how you feel. Even in the United States, the demand for TI products often exceeds the supply.

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Dear Sir:

Thank you for your very favorable review of our multi-disk catalog program—Super Cataloger, (March issue, pages 20-21). However the reviewer neglected to mention that the price quoted in the article ($19.95) was a special introductory price and that it expired on April 1, 1983. The current (and regular) price is $29.95. Also, Super Cataloger will run on both the 99/4 and 99/4A computers.

Also, Super Cataloger is completely compatible with both the TI-Writer and the Editor/Assembler modules. The output of Super Cataloger can be directed to a disk file (instead of the printer) by specifying the print device as: DSK1.SUPERCAT. This creates a disk file that can be read by either TI-Writer or Editor/Assembler and then edited, modified, updated, formated, etc. It also allows you to re-print the catalog at any time.

Larry Hughes
Washington, DC

Sorry for the oversight, Larry.

Dear Sir:

Thank you for this opportunity to respond to your (March 1983) review of our *Shuttle Command* game program. Before doing so, however, we would like to correct a typographical error which appeared in the article. Our address is P.O. Box 4169 and not 4196 as was printed.

On the whole, we believe the review to have been quite fair. After all, how could we argue with its stated assessment that "*Shuttle Command* does have several nice features that make it, perhaps, the best game of its type for the TI-99/4A." However, there were negative aspects to the review which disturbed us greatly.

Programming a game requires that a balance be struck between the flow of action and the limitations of the language and/or hardware used to implement it. The previously quoted assessment, coupled with the review's summary that "*Shuttle Command* does have several nice features: some pleasing arcade effects, unusual rewards for shooting accuracy, and an instrument panel that really 'works'.", seems to attest to the successful implementation of game action flow. But after accentuating the many positive factors which our program possesses, your reviewer faults it for the graphical method to simulate the 3-dimensional approach of the enemy craft.

For those of you who have not seen our program in action, the approach of the enemy craft is achieved by making it grow from a mere dot to full size in eight incremental steps. Could more steps have been used in order to smooth out the appearance of growth? Of course—but it would have been at the expense of those "several nice features" which make our game unique.

Extended BASIC does not redefine graphic characters very quickly, so in order to keep the pace of play from dragging, the shapes used in the growth steps had to be pre-defined. Since these eight shapes (32 characters), coupled with the graphic reqirements of the "several nice features", used up all 112 redefineable characters permitted by Extended BASIC, no smoother growth was possible.

Toward the end of the review, *Shuttle Command* is again faulted. This time, your reviewer wondered "if the game couldn't offer a bit more variety." The response to this statement is of course it could. But, again, to have done so would have required sacrificing some more of the "several nice features" pointed out in the review. There are points that occur when the program is running where less than 1200 bytes of RAM remain free. This was simply not enough memory to allow for any additional variety in the game.

The program which your reviewer offers as an example of a space battle game with more variety is *Star Raiders*. We are flattered by his choice for comparison. For those of you not familiar with the *Star Raiders* game—it has won some sort of game-of-the-year award, it is written *entirely* in machine language, it is far larger in size than the 16,000 bytes of memory resident in the unexpanded TI-99/4A, and is *not* available for the Texas Instruments Home Computer in any form whatsoever!

As far as comparisons go, even TI's best machine language effort—*Parsec*—pales before the like of *Star Raiders*. How do we feel *Shuttle Command* compares? Why . . . we have never pretended that our Extended BASIC game was even in the same league as *Star Raiders*! But then, *Shuttle Command* only costs $17.50 whereas *Star Raiders* lists for $45.

As luck would have it, on the same day we received our copy of the review, we also received a letter from a Mr. Thomas Arnold of Fort Worth, Texas. Mr. Arnold opens his letter to us as follows: "Your two programs '*Shuttle Command* and *TI-Asteroids*' are great. I had no idea that Extended BASIC would perform so well!" Mr. Arnold's enthusiasm is echoed by many other letters that we have received from purchasers who also took the time to write to us. They all appear to agree with your reviewer's assessment that "*Shuttle Command* does have several nice features that make it, perhaps, the best game of its type for the TI-99/4A." And at $17.50, we believe it to be a better value for the money than the likes of *Blasto, Video Games I, Hunt The Wumpus*, etc.—all written in machine language, by the way!

Rick Rothstein, President
FFF SOFTWARE
Trenton, NJ

Thank you, Rick, for pointing out our printing error on your address. Check out the new review format in this issue—we keep trying to do it better.

Send in Your Photos and Anecdotes

Do you have a favorite photograph (color or black and white) featuring an unusual application of your Home Computer? Would you like to share your unusual or amusing anecdotes relevant to Home Computing? *99'er Home Computer Magazine* will pay $25 for items it publishes. Material chosen will be subject to the same copyright treatment as "Letters to the Editor" as set forth on the Masthead page. No submissions can be returned. Send anecdotes and copies of photos to: Pot Pourri Editor, 99'er Home Computer Magazine, 1500 Valley River Drive, Suite 250, Eugene, Oregon 97401.

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10. **What is your ZIP code?** ☐☐☐☐☐

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1. **Do you intend to buy a TI computer?** ☐No ☐Yes (within 3 months) ☐Yes (within 3-6 months) ☐Yes (within 6-12 months)
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3. **What do you anticipate your primary use of a TI computer will be?** ☐Entertainment ☐Education ☐Computer literacy ☐Household management ☐Job-related homework ☐Business ☐Professional use

FOR PRESENT TEXAS INSTRUMENTS COMPUTER USERS

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6. **Put a CIRCLE around the above peripheral you are most likely to buy within the next 6 months.**
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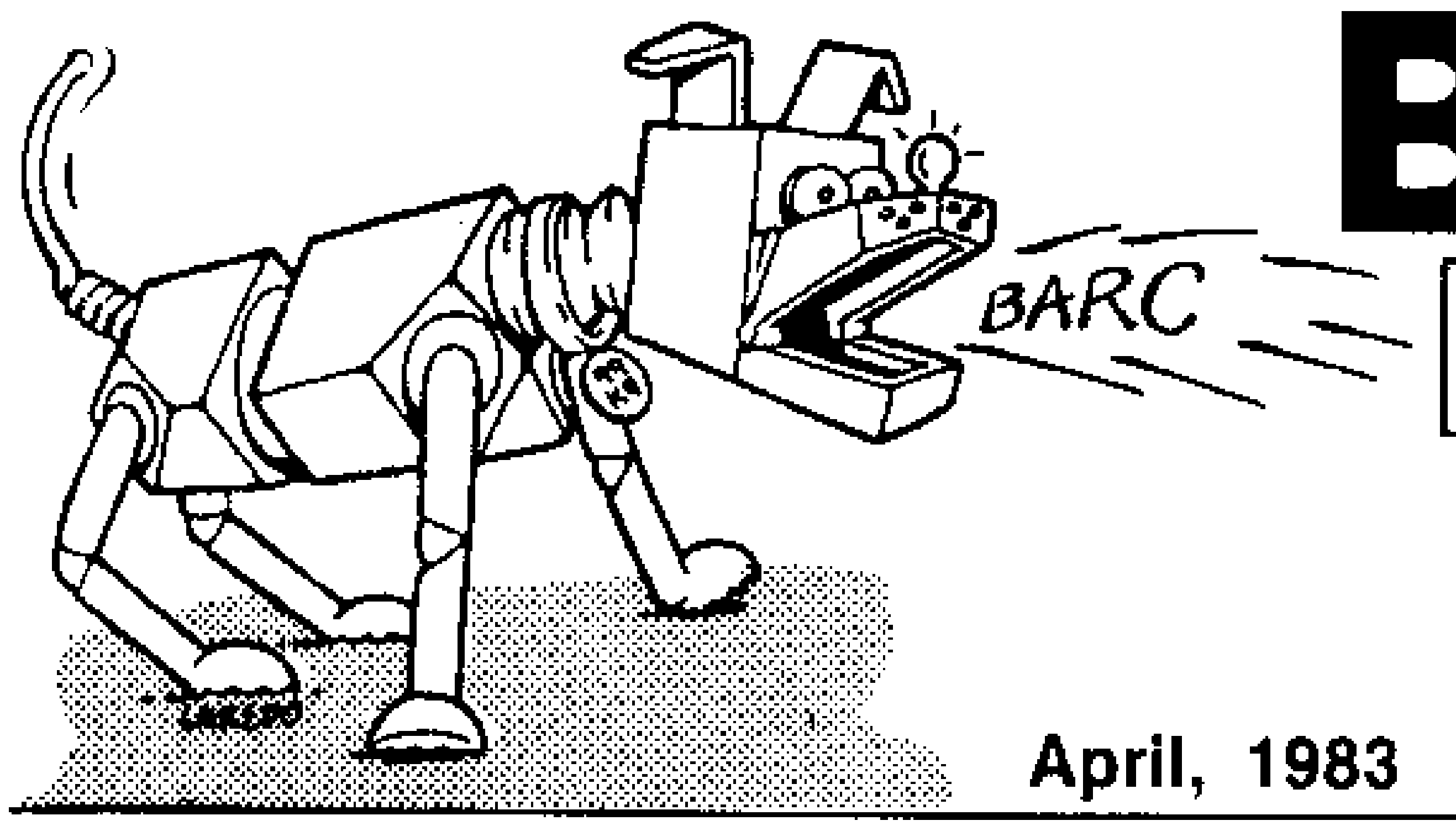

B.A.R.C.* BACK

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April, 1983

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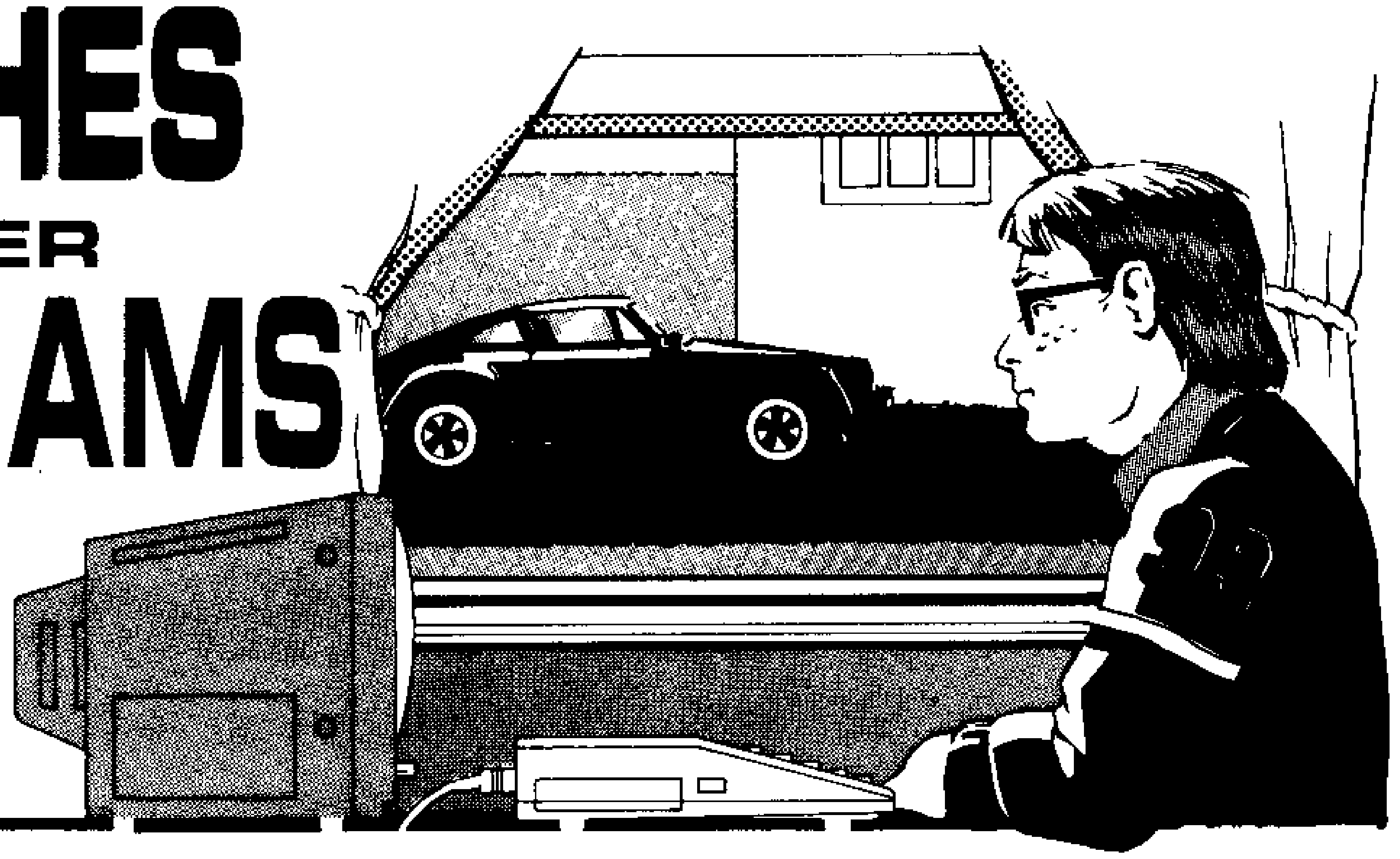


Computer Assisted Savings Planning

By Joel S. Moskowitz, J.D.
2410 El Pavo Way
Rancho Cordova, CA 95670

When it comes time to make an expensive purchase—a car, stereo, refrigerator—those of us without large cash reserves often find ourselves comparing costly payment plans, wheedling friends for money, or searching endlessly for super-bargains that don't exist.

If you lack the optimism to count on the Readers Digest Sweepstakes, or the ghoulish patience to await the demise of your rich uncle, you will have to look to other sources for the filthy stuff. You may find, after you exclude all the improbable, immoral and illegal alternatives, that you are left with the old fashioned, character-building method: *saving* the money.

Here is a program that provides helpful routines for setting up your own personal savings plan. It also illustrates the enormous usefulness of the DISPLAY AT and ACCEPT AT functions of TI Extended BASIC. After your data is entered on the screen (with default values to prevent input errors), you have the opportunity to isolate and change a variable such as the interest rate, or the time periods. And you can immediately see the effect of that change while the rest of your data remains on the screen.

To help explain what the program does, I will tell a sad-but-true tale of one young man, and how he used the routines in this program.

Jim had never been able to save much money. To encourage him, his father offered to sell him his new Porsche for only $4,000 if Jim could save the money in three years. The deal was too good to pass up, but Jim had only $500 in the bank, and his new job didn't pay much yet.

Anyone looking forward to a future expense (such as a balloon payment on a mortgage, or a trip to Hawaii next year) will see something familiar in Jim's story.

Could Jim make it? His first step was to find out what his $500 would amount to in three years. Then he could start thinking about saving the rest. For this first task, Jim selected the Compound Interest routine.

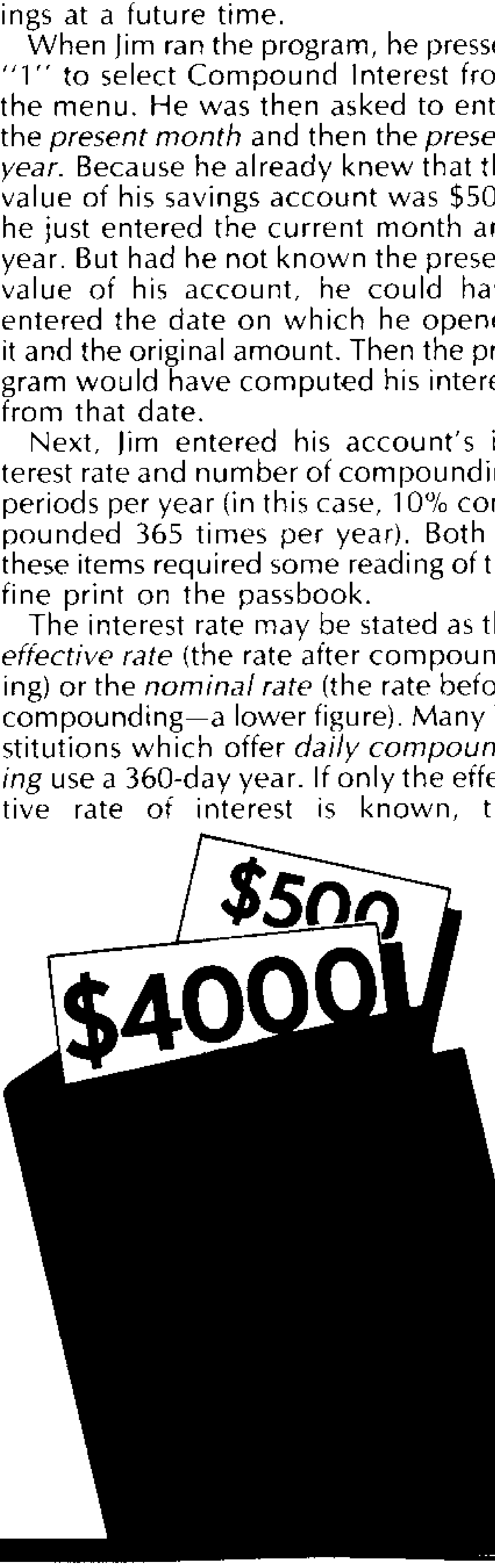
Routine 1: Compound Interest

Just as banks use a compound interest routine to figure how much interest they owe on their savings accounts, Jim used his 99/4 to project the value of his savings at a future time.

When Jim ran the program, he pressed "1" to select Compound Interest from the menu. He was then asked to enter the *present month* and then the *present year.* Because he already knew that the value of his savings account was $500, he just entered the current month and year. But had he not known the present value of his account, he could have entered the date on which he opened it and the original amount. Then the program would have computed his interest from that date.

Next, Jim entered his account's interest rate and number of compounding periods per year (in this case, 10% compounded 365 times per year). Both of these items required some reading of the fine print on the passbook.

The interest rate may be stated as the *effective rate* (the rate after compounding) or the *nominal rate* (the rate before compounding—a lower figure). Many institutions which offer *daily compounding* use a 360-day year. If only the effective rate of interest is known, the number of compounding periods should be set at "1."



Finally, Jim entered the *present amount* (the amount in his account as of the *present date*), which was $500. The program then informed him that in three years his account would be worth $674.90, noting that he would earn $174.90 in interest.

This was a big help in Jim's search for the $4000. He had *only* $3325.10 to go. Let's see how he could get it.

Routine 2: Level Payments

Because people rarely save the money *left over* at the end of each month, it is usually more effective to set aside a certain amount immediately upon receiving a paycheck. Jim needed to know how much to set aside each month in order to get his $3325.10 at the end of three years. The Level Payments routine gave him that answer.

As in the case of the Compound Interest routine, Jim entered the present and future dates, the rate of interest and the number of compounding periods per year. Next he was asked how many payments per year he planned to make. Because Jim was paid monthly, he entered "12." Finally, he entered the amount he would need at the end of the three year period: $3325.10.

A push of the ENTER button, and Jim found that he had to set aside $78.87 each payday in order to reach his goal. Jim knew he couldn't save that much each month. Was he sunk? Not yet. He could try the Increasing Payments routine.

Routine 3: Increasing Payment

The problem with level payment plans is that the payments are often too high and they do not take into account any ability to pay a greater amount later on. The mortgage industry has responded to this situation by introducing Graduated Payment Mortgages, in which the payments rise a fixed percentage each year, as one's salary (hopefully) rises. The same technique which allows peo-

Continued on p. 12

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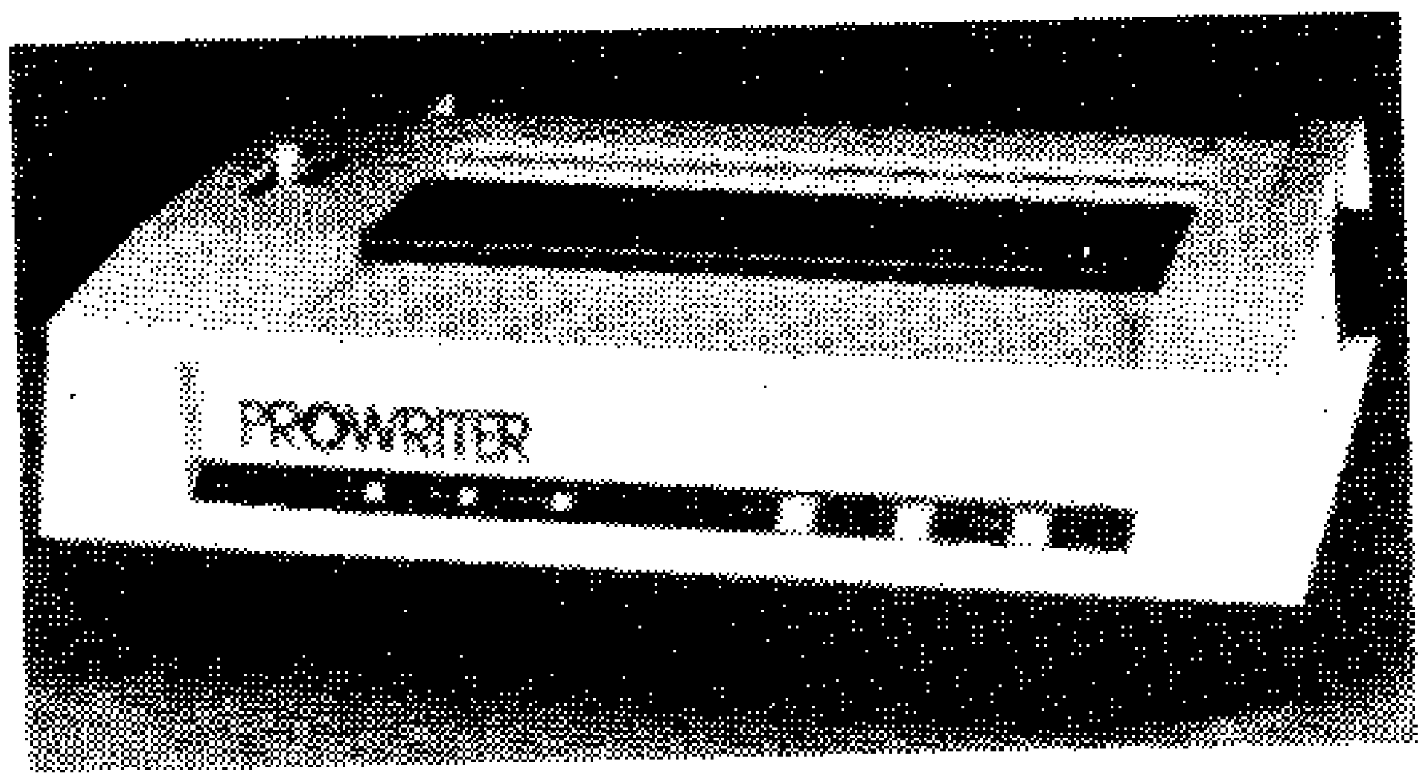

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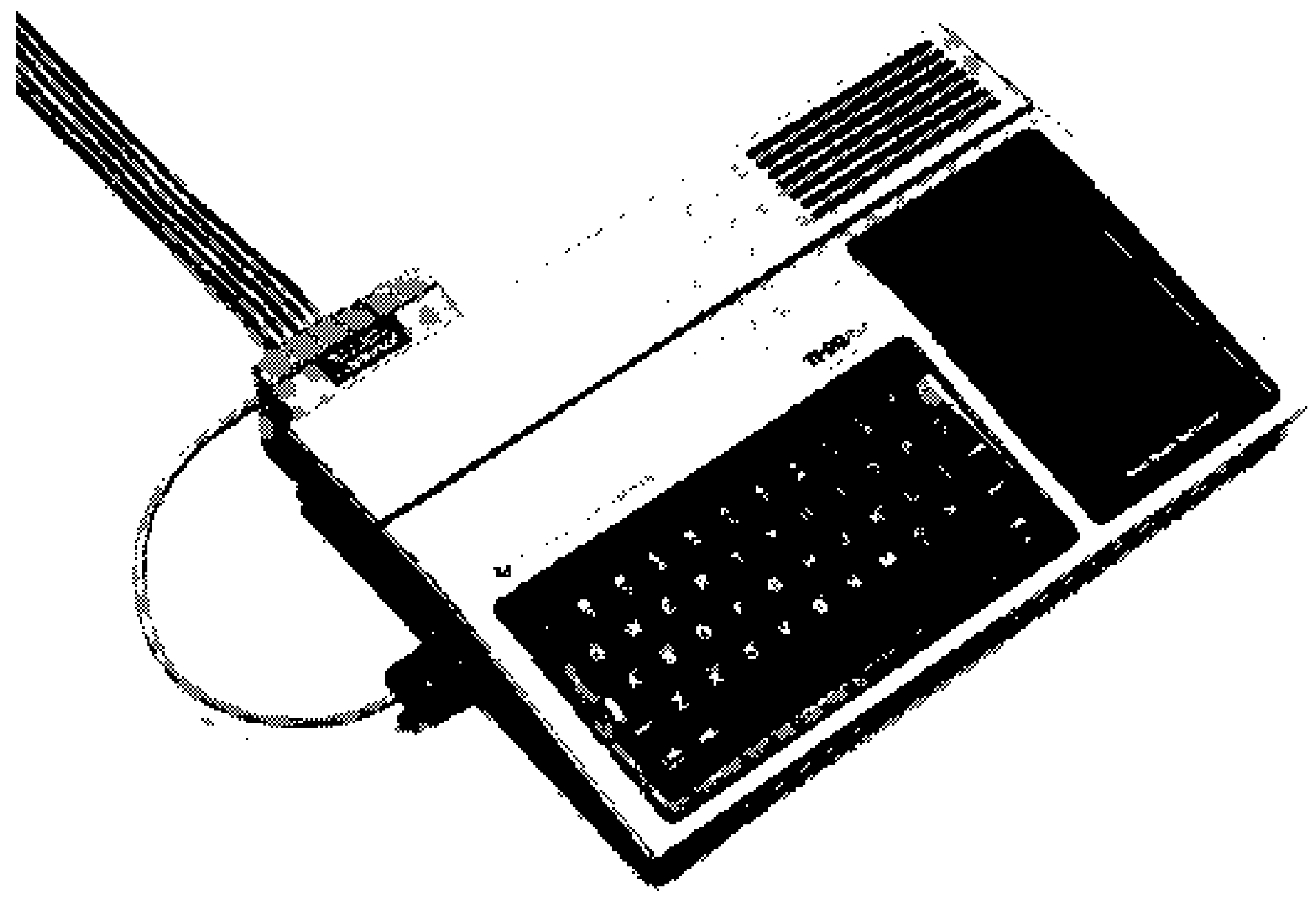

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SAVINGS . . . from p. 9

ple to buy houses can let them buy other things they otherwise could not afford.

Under this plan, the payments will start off lower, remain level for a year, and then rise by the percentage set for the next year—and so on until the future date arrives. The initial payments are most profoundly reduced when the savings period extends over many years, as in the case of a 30-year mortgage. In such a case, the first year's payments are much lower than those of later decades.

There is a price to pay for the luxury of lower initial payments. Under the Level Payments plan, more money is saved during the early years, and this extra money goes right to work earning interest. The Level Payments plan is therefore always cheaper than the Increasing Payments plan. And yet, this should stop no one from using the Increasing Payments plan if it would help. After all, it would be cheaper still to forget about payments altogether and put away a lump sum which will grow into the amount needed. It would not be practical however, and that is what savings plans are all about.

Getting back to Jim, he selected the Increasing Payment plan from the menu. The program asked him the same questions it asked in the Level Payments routine, as well as what percentage he would like his payments to rise each year.

Jim figured that his salary would rise by 5% each year, so he entered "5." To Jim's dismay he found that his payments were only lowered to $73.30 each month. Jim shouldn't have been surprised, though. After all, his payments at the end of the three-year period would only be a little more than 10% higher than they were at the beginning. In any case, he needed to give his project more thought.

Routine 4: Future Value, Fixed Payments

After running his expenses through the Household Budget Management cartridge, Jim realized that the most he could save was $50 per month. How much would that give him at the end of three years?

This routine asked Jim the same questions as the Level Payments routine, except that instead of asking him how much money he needed, it wanted to know how much he was prepared to save at the beginning of each period. Jim entered "$50." He was told that his payments plus the interest would add up to $2107.86 at the end of three years. This amount, plus the future value of his savings account, was more than $1200 short.

That left Jim with three basic options. He could (1) negotiate a better deal with his dad; (2) find a way to afford more savings; or (3) change some of the assumptions he had built into his calculations. This program makes this last option easy.

After an answer is given at the end of each routine, the program provides a choice of (1) changing the data; (2) switching to another routine; or (3) ending the program. When the user chooses to change the data, the program asks which of the numbered items should be changed. Once that item is selected and changed, the answer will be recalculated and displayed. All of the other items will remain unaltered on the screen. The data can be changed to isolate the effects of varying time periods, interest rates or payment amounts. This feature is very useful for comparing investments. For example, it could figure which is better: a certificate that pays 10½% interest and compounds quarterly, or a certificate that pays 10% and compounds daily?

As for Jim, he was last seen driving around in a 1973 Toyota Corolla with a wrinkled rear end. Obviously not *everyone's* money worries can be solved by this program. But these routines will help define problems, and thereby aid Home Computer users in charting a path through the financial wilderness.

99'er

EXPLANATION OF THE PROGRAM
SAVINGS

Line No.	
170-230	DIMension and DEFine variables.
240-320	Title screen.
330-390	Menu.
400-450	Compound interest.
460-550	Level payments.
560-760	Increasing payments.
770-860	Future value, fixed payments.
870-1240	Input subroutines.
1250-1260	Error handling routine.

```
100 REM ****************
110 REM *    SAVING    *
120 REM ****************
130 REM BY JOEL S. MOSKOWITZ
140 REM 99'ER VERSION 2.6.1XB
150 ON WARNING NEXT
160 ON ERROR 1250
170 DIM CA(25),PRE(25)
180 DEF PV=(1-1/(1+I)^N)/I
190 DEF FV=((1+I)^N-1)/I
200 DEF G=F*CA(Z)/P
210 DEF CP=P*ND/F
220 DEF COM=PRE(X)*(1+IN/(100*K))^
(K*TY)
230 DEF RD(A)=INT(A*100+.5)/100
240 REM TITLE SCREEN
250 CALL CLEAR :: CALL SCREEN(11):
: CALL COLOR(14,2,13)
260 CALL CHAR(128,"B0703E1F0700000
00E7CF8E")
270 CALL CHAR(136,"FF80B9BABAB9B0F
FFF0111A9A91101FF")
280 DISPLAY AT(9,12):"SAVING":TAB(
5);"_______________": :
: : :TAB(14);"BY": :TAB(7);"JO
EL S. MOSKOWITZ"
290 FOR Z=1 TO 24 STEP 23
300 FOR I=3 TO 30 STEP 5 :: CALL H
CHAR(Z,I,128):: CALL HCHAR(Z,I
+1,136):: CALL HCHAR(Z,I+2,137
)
310 CALL HCHAR(Z,I+3,129):: CALL V
CHAR(2,3,36,21):: CALL VCHAR(Z
,31,36,21):: NEXT I :: NEXT Z
320 FOR DELAY=1 TO 400 :: NEXT DEL
AY
330 REM MENU
340 CALL CLEAR :: CALL SCREEN(8)
350 DISPLAY AT(7,2):"CHOOSE:":" :"
  1. COMPOUND INTEREST": :"  2
. LEVEL PAYMENTS": :"  3. INCR
EASING PAYMENTS"
```

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```
360 DISPLAY AT(15,2):"4. FUTURE VA
    LUE,":"   FIXED PAYMENTS"
370 CALL KEY(0,KY,ST):: IF ST=0 OR
     KY<49 OR KY>52 THEN 370 :: CA
    LL CLEAR
380 GOSUB 890 :: GOSUB 930 :: GOSU
    B 1000 :: GOSUB 1030
390 ON KY-48 GOTO 400,470,570,780
400 REM COMPOUND INTEREST
410 GOSUB 1100
420 DISPLAY AT(14,1):"FUTURE SAVIN
    GS= $";STR$(RD(COM)): :"TOTAL
    INTEREST= $";STR$(RD(COM-PRE(X
    )))
430 GOSUB 1050 :: ON KY-48 GOSUB 4
    40,340,1240
440 GOSUB 1070 :: ON C GOSUB 890,9
    30,1000,1030,1100 :: IF C=1 TH
    EN ON C GOSUB 960
450 GOTO 420
460 REM LEVEL PAYMENTS
470 GOSUB 1130 :: GOSUB 1160
480 I=R/K :: TY=Y+M/12 :: TP=INT(N
490 N=K/NP*TP :: F=FV
500 N=K/NP :: P=PV :: TY=(M/(12/NP
    )-INT(M/(12/NP)))/NP :: IF TY=
    0 THEN 510 :: ND=ND/(1+IN/(100
    *K))^(K*TY)
510 DISPLAY AT(16,1):"LEVEL PAYMEN
    TS = $";STR$(RD(CP))
520 GOSUB 1050
530 ON KY-48 GOTO 540,340,1240
540 GOSUB 1070 :: ON C GOSUB 890,9
    30,1000,1030,1130,1160 :: IF C
    =1 THEN ON C GOSUB 960
550 GOTO 480
560 REM INCREASING PAYMENTS
570 GOSUB 1130 :: GOSUB 1160 :: GO
    SUB 1190
580 I=R/K :: TY=Y+M/12
590 IF TY>=1 AND TY<=25 THEN 620 E
    LSE DISPLAY AT(20,1):"TIME PER
    IOD MUST BE":"FROM 1 TO 25 YEA
    RS."
600 DISPLAY AT(22,1):"USE ROUTINE
    2 FOR":"A DIFFERENT PERIOD"
610 GOSUB 890 :: GOSUB 930 :: GOTO
     590
620 X=0 :: A=0 :: CA(1)=1 :: N=K/N
    P :: P=PV :: N=K :: F=FV :: Z=
    1 :: PRE(1)=G
630 FOR Z=2 TO Y+1 :: CA(Z)=CA(Z-1
    )*(1+RA/100):: PRE(Z)=G :: NEX
    T Z
640 IF Y=0 THEN 680
650 FOR X=1 TO Y :: TY=TY-1
660 IF TY=0 THEN A=A+PRE(X)ELSE A=
    A+COM
670 NEXT X
680 IF M<12/NP THEN 700
690 Z=X :: N=K/NP :: P=PV :: N=K/N
    P*INT(M/(12/NP)):: F=FV :: A=A
    +G
700 TY=(M/(12/NP)-INT(M/(12/NP)))/
    NP :: IF TY=0 THEN 710 :: PRE(
    X)=CA(X):: A=A+COM
710 PA=ND/A
720 DISPLAY AT(17,1):"1st PERIOD P
    AYMENT= $";STR$(RD(PA)): : :
730 GOSUB 1050
740 ON KY-48 GOTO 750,340,1240
750 GOSUB 1070 :: ON C GOSUB 890,9
    30,1000,1030,1130,1160,1190 ::
     IF C=1 THEN ON C GOSUB 960
760 GOTO 580
770 REM FUTURE VALUE, FIXED PAYMEN
    TS
780 GOSUB 1130 :: GOSUB 1220
790 I=R/K :: Z=1 :: TY=Y+M/12 :: T
    P=INT(NP*TY):: IF TP=0 THEN TP
    =1
800 N=K/NP :: P=PV :: N=K/NP*TP ::
     F=FV :: A=G
810 TY=(M/(12/NP)-INT(M/(12/NP)))/
    NP :: IF TY=0 THEN 820 :: PRE(
    X)=A :: A=COM
820 DISPLAY AT(17,1):"SAVINGS WILL
    = $";RD(A): : :
830 GOSUB 1050 :: ON KY-48 GOTO 84
    0,340,1240
840 GOSUB 1070 :: ON C GOSUB 890,9
    30,1000,1030,1130,1220 :: IF C
    =1 THEN ON C GOSUB 960
850 GOTO 790
860 GOSUB 1050
870 REM INPUT SUBROUTINES, ALL PRO
    GRAMS
880 CALL CLEAR
890 DISPLAY AT(1,1):"1. PRES. MONT
    H        : 1" :: ACCEPT AT(1,23)
    SIZE(-2)VALIDATE(DIGIT)BEEP:PM
900 IF PM<1 OR PM>12 THEN 890
910 DISPLAY AT(1,15)SIZE(5):"/YEAR
    " :: DISPLAY AT(1,25):"/84"
920 ACCEPT AT(1,26)SIZE(-4)VALIDAT
    E(DIGIT)BEEP:PY :: RETURN
930 DISPLAY AT(3,1):"2. FUT. MONTH
            : 4" :: ACCEPT AT(3,23)
    SIZE(-2)VALIDATE(DIGIT)BEEP:FM
940 IF FM<1 OR FM>12 THEN 930
950 DISPLAY AT(3,15)SIZE(7):"/YEAR
    " :: DISPLAY AT(3,25):"/88" ::
     ACCEPT AT(3,26)SIZE(-4)VALIDA
    TE(DIGIT)BEEP:FY
960 Y=FY-PY :: M=FM-PM :: IF M>=0
    THEN 970 :: M=M+12 :: Y=Y-1
970 TY=Y+M/12
980 IF TY<=0 THEN DISPLAY AT(5,1):
    "*TIME MUST BE LONGER THEN 0*"
     :: GOTO 930
990 DISPLAY AT(5,1):" (=";Y;"YEARS
     AND";M;"MONTHS)" :: RETURN
1000 DISPLAY AT(7,1):"3. PERCENT IN
     TEREST:  9.9" :: ACCEPT AT(7,2
     3)SIZE(-6)VALIDATE(DIGIT,".")B
     EEP:IN
1010 IF IN<=0 THEN 1000
1020 R=IN/100 :: RETURN
1030 DISPLAY AT(9,1):"4. COMPOUNDS/
     YEAR:     360"
1040 ACCEPT AT(9,23)SIZE(-3)VALIDAT
     E(DIGIT)BEEP:K :: IF K<=0 THEN
      1040 :: RETURN
1050 DISPLAY AT(20,1): :"PRESS:":"
     1. TO ENTER NEW DATA.":" 2. TO
      SELECT NEW ROUTINE":" 3. TO E
     ND THIS SESSION"
1060 CALL KEY(0,KY,ST):: IF ST=0 OR
      KY<49 OR KY>51 THEN 1060 :: R
     ETURN
1070 DISPLAY AT(20,1):"ENTER THE NU
     MBER OF THE ITEM":"YOU WISH TO
      CHANGE: 1": : : : ::
1080 ACCEPT AT(21,21)VALIDATE(DIGIT
     )SIZE(-1):C :: RETURN
1090 REM INPUT SUBROUTINE FOR PROGR
     AM 1
1100 DISPLAY AT(11,1):"5. PRESENT A
     MOUNT: $100" :: ACCEPT AT(11,2
     1)SIZE(-8)VALIDATE(DIGIT,".")B
     EEP:PRE(X)
1110 IF PRE(X)<=0 THEN 1100 :: RETU
     RN
1120 REM INPUT SUBROUTINE FOR PROGR
     AMS 2, 3, AND 4
1130 DISPLAY AT(11,1):"5. PAYMENTS/
     YEAR:       12" :: ACCEPT AT(11,
     23)SIZE(-3)VALIDATE(DIGIT)BEEP
     :NP
1140 IF NP<=0 THEN 1130 :: RETURN
1150 REM INPUT SUBROUTINE FOR PROGR
     AMS 2 AND 3
1160 DISPLAY AT(13,1):"6. AMOUNT NE
     EDED: $950.45" :: ACCEPT AT(13
     ,20)SIZE(-10)VALIDATE(DIGIT,".
     ")BEEP:ND
1170 IF ND<=0 THEN 1160 :: RETURN
1180 REM INPUT SUBROUTINE FOR ROUTI
     NE 3
1190 DISPLAY AT(15,1):"7. % INCREAS
     E/YEAR:   5" :: ACCEPT AT(15,2
     3)SIZE(-2)VALIDATE(DIGIT,".")B
     EEP:RA
1200 IF RA<0 THEN 1190 :: RETURN
1210 REM INPUT SUBROUTINE FOR ROUTI
     NE 4
1220 DISPLAY AT(13,1):"6. PAYMENT A
     MOUNTS:  $100" :: ACCEPT AT(13
     ,23)SIZE(-5)VALIDATE(DIGIT,"."
     )BEEP:CA(1)
1230 IF CA(1)<0 THEN 1220 :: RETURN
1240 STOP
1250 CALL CLEAR :: CALL SOUND(500,1
     10,0,220,0)
1260 DISPLAY AT(12,1)BEEP:"BAD ERRO
     R---OOPS---TRY AGAIN" :: GOTO
     330
```

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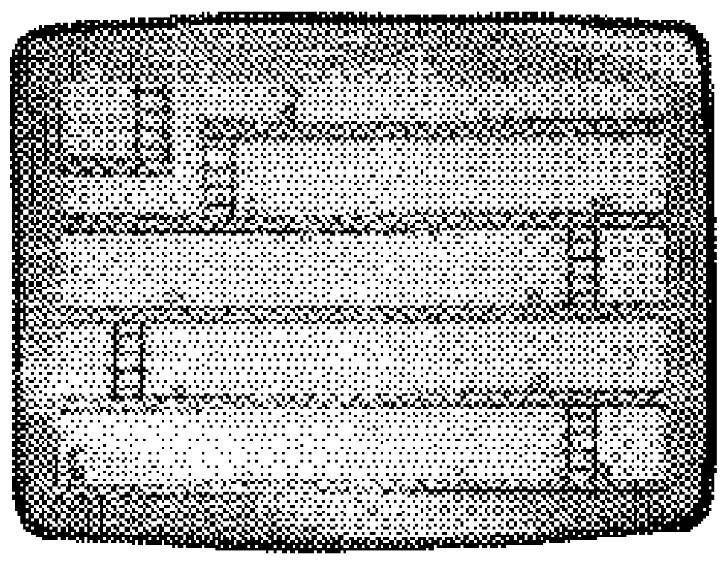

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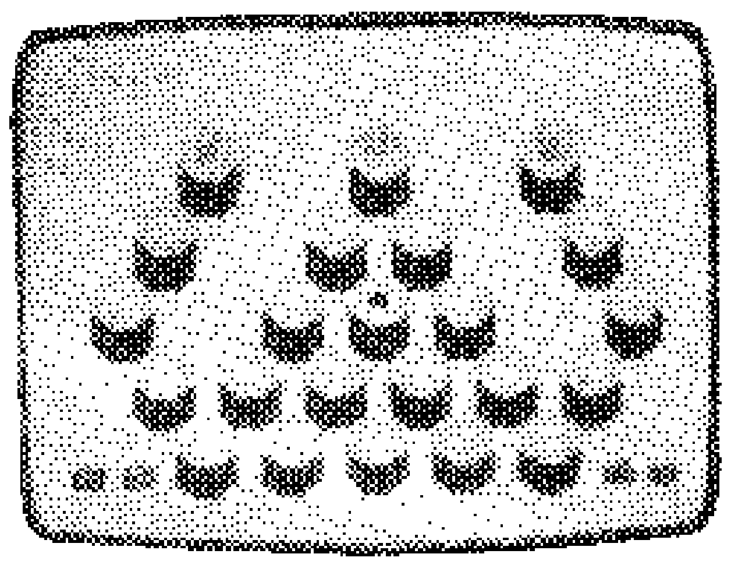

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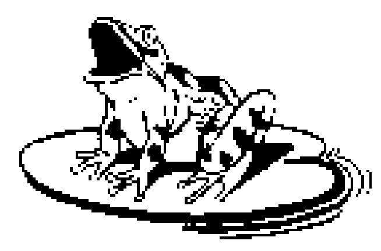

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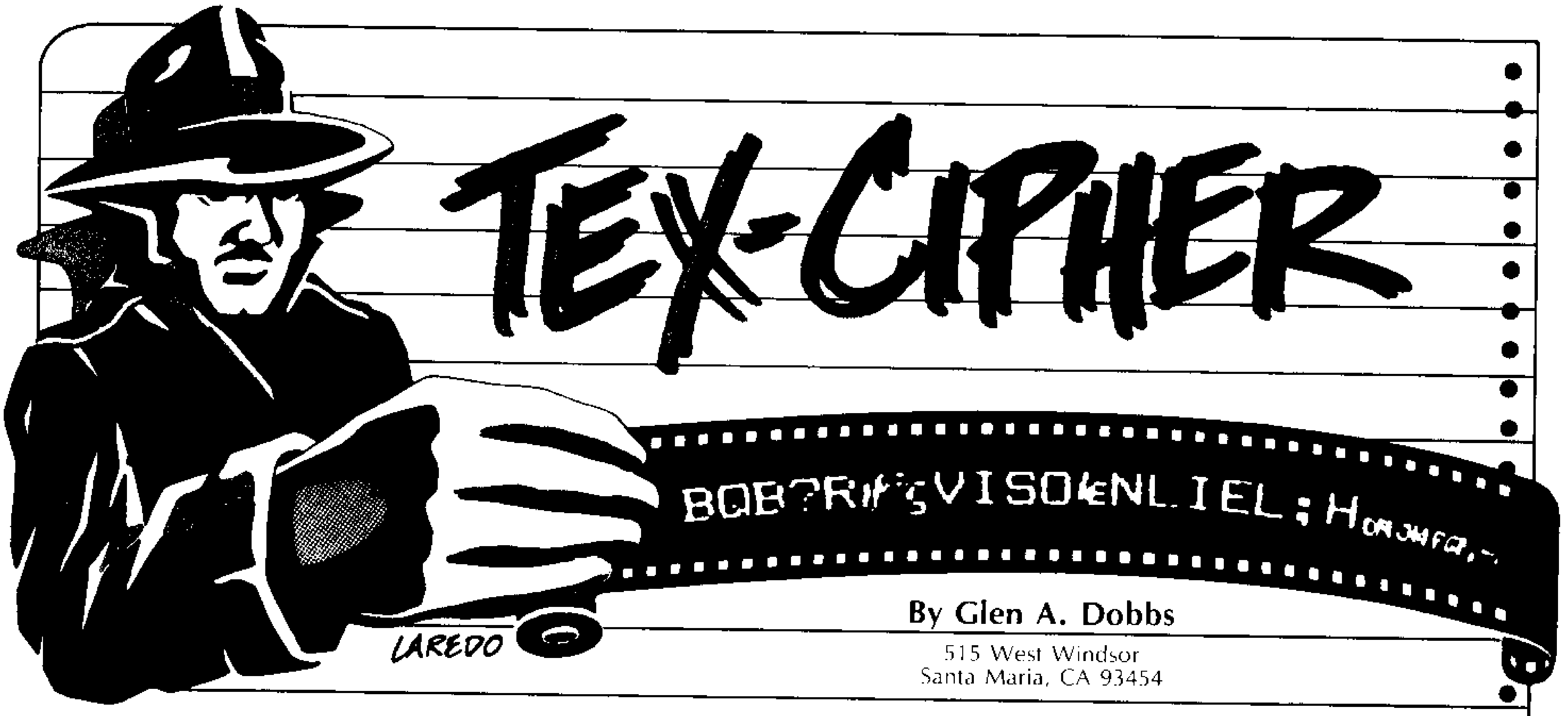

By Glen A. Dobbs

515 West Windsor
Santa Maria, CA 93454

Secret codes for warfare date back to earliest times. By the beginning of the fifteenth century, these codes were widely used by governments, but individuals who used them were considered suspect. Under those conditions, this article would not have been very well received, I'm sure.

However, not all codes are secret. Thousands of overt codes are in use today; indeed, without them we would probably find it very difficult to get along. In the world of computing, for example, where would we be without ASCII code?

Secret codes can be produced very nicely on the TI-99/4A by taking advantage of the RND function. Checking the *User's Reference Guide* and the *TI Extended BASIC Manual*, we find that in a current sequence of pseudo-random numbers, the RND function returns the next number—the sequence of numbers being the same each time a program is run. There is one variant to this statement: If we run a program in TI BASIC and then in TI Extended BASIC, or vice versa, the two languages return pseudo-random numbers different from each other. Staying within either language, however, you will get a repeatable series.

The pseudo-random numbers returned by the two BASIC languages are always less than one, and greater than or equal to zero. Because a fractional number is difficult to deal with, let's convert it to an integer with a statement like A = INT(RND*6) + 1. This statement will return a varying number between one and six in the variable A. Interjecting a note of caution at this point, do not use the RANDOMIZE function in conjunction with RND in your program. If you do, you will get back a truly random sequence, and although you can still code something with these numbers, you will never be able to decode the information again. So for now, let's make sure to leave out RANDOMIZE.

How often does a pseudo-random number repeat itself? I can answer only theoretically, saying that it won't repeat on the TI-99/4A in at least two and one half million times; I ran a program that checked that far. For those of you who may wish to repeat my experiment, or possibly take it farther, here is the program that I used.

```
100 FOR I = 1 TO 1000000000
110 A = RND
120 IF I = 1 THEN 130 ELSE 140
130 B = A
140 IF B = A THEN 160
150 NEXT I
160 PRINT "MATCH";I;"MADE"
170 GOTO 150
```

Be prepared to let this program run a long time, possibly for a day or so. My program ran overnight to reach the two-and-a-half million mark.

To successfully code information, we want predictable results (predictable to us that is, not to the other guy) so that we can reverse the procedure and unscramble what we coded in the first place. The RND function allows this capability, and when we use it with the INT function, mentioned previously, we have a powerful tool in our varying code KEY. We can code using 1) pseudo-random numbers between one and six (as I did in my program), 2) every other number between one and six, 3) every number between one and ten, and so on. The ways that RND can be used as a code KEY are limited only by one's imagination. Feel free to experiment and modify the program code KEY to ensure your own data security. Just remember that you have to reverse the procedure in the decode program so the data can be recovered later.

One further caution for those of you who key in the program in TI BASIC instead of TI Extended BASIC: In TI BASIC you will have to avoid leading blanks and commas in your INPUT statements or the program will stop with an error. One possible way around this limitation is to use READ and DATA statements with the DATA enclosed in quotes—but this is not as satisfactory as TI Extended BASIC's LINPUT statement.

Now let's look at the Code program and see how it works. After that, we'll take a look at the Decode program.

EXPLANATION OF THE PROGRAM
Tex-Cipher

CODE

Line Nos.	
100-190	Header and REMS.
200-210	Clear screen and open disk file.
220	Input string to be coded.
230-300	Convert string into code.
310-320	Print code to disk and display it on screen.
330-350	Set up for another string.
360-370	Close disk file. End of program.

```
100 REM *****************
110 REM * CODE PROGRAM *
120 REM *****************
130 REM BY GLEN A. DOBBS
140 REM 99'ER VERSION 2.6.1
150 REM
160 REM
170 REM
180 REM
190 REM
200 CALL CLEAR
210 OPEN #1:"DSK1.CODE",RELATIVE,I
NTERNAL
220 INPUT "INPUT DATA NOW PLEASE":
A$
230 FOR I=1 TO LEN(A$)
240 A=INT(RND*6)+1
250 B$=SEG$(A$,I,1)
260 B=ASC(B$)
270 C=B-A
280 C$=CHR$(C)
290 D$=D$&C$
300 NEXT I
310 PRINT #1,REC T+1:D$
320 DISPLAY D$
330 D$=""
340 T=T+1
350 IF T<10 THEN 220
360 CLOSE #1
370 END
```

The Code program will run in both TI BASIC and TI Extended BASIC as written. If you use TI Extended BASIC, change the INPUT statement on line 220 to LINPUT. This will give you the ability to enter leading blanks, commas, etc. The Decode program runs in both languages without any modifications.

Lines 240 through 290 do the work of the code program with line 240 itself being the pseudo-random code KEY used to offset each typed character. The actual offsetting of the character is then accomplished in line 270. Segment the character from the string in line 250 and get the ASCII value in line 260. After coding the character in line 270, use lines 280 and 290 to reassemble the new string, character by character. By then it will be unintelligible.

That's it. The Decode program is merely a reversal of the Code program, and works exactly the same way. Line 220 (the printer OPEN statement) should be modified to work with your printer. Now you have the tools to secure your data from prying eyes. Happy coding!

EXPLANATION OF THE PROGRAM
Tex-Cipher
DECODE

Line Nos.	
100-190	Header and REMS.
200-210	Clear screen and open disk file.
220	Open RS232 port to printer.
230	Restore file to first record number.
240-380	Input record from disk, and convert into readable form.
390-410	Close the disk and printer files, End program.

```
100 REM ********************
110 REM * DECODE PROGRAM *
120 REM ********************
130 REM BY GLEN A. DOBBS
140 REM 99'ER VERSION 2.6.1
150 REM
160 REM
170 REM
180 REM
190 REM
200 CALL CLEAR
210 OPEN #1:"DSK1.CODE",RELATIVE,I
NTERNAL
220 OPEN #2:"RS232.BA=9600.DA=8.PA
=N"
230 RESTORE #1,REC 1
240 FOR Z=1 TO 10
250 INPUT #1,REC Z:A$
260 FOR I=1 TO LEN(A$)
270 A=INT(RND*6)+1
280 B$=SEG$(A$,I,1)
290 B=ASC(B$)
300 C=B+A
310 C$=CHR$(C)
320 D$=D$&C$
330 IF I>=LEN(A$)THEN 340 ELSE 360
340 DISPLAY D$
350 PRINT #2:D$
360 NEXT I
370 D$=""
380 NEXT Z
390 CLOSE #1
400 CLOSE #2
410 END
```

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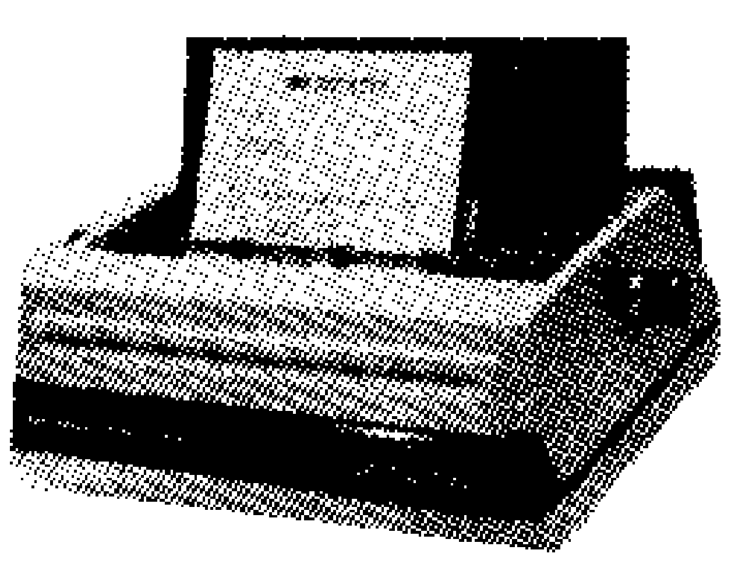

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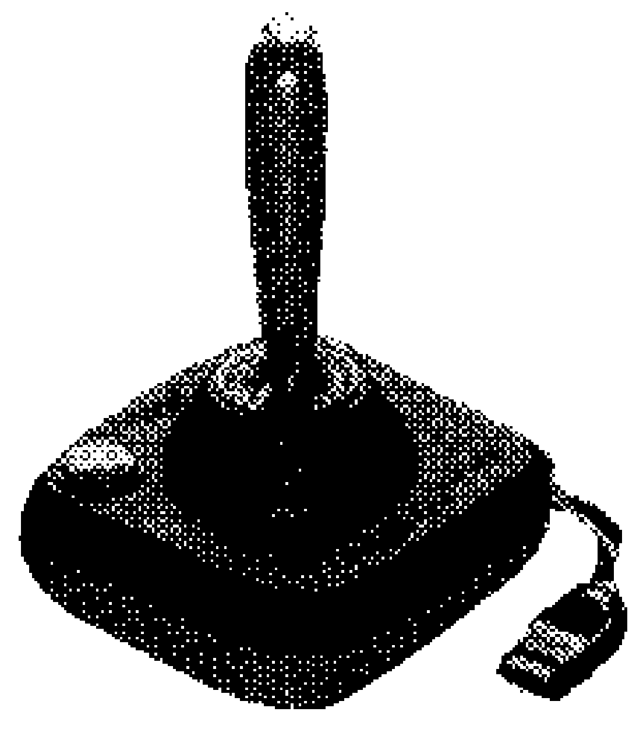

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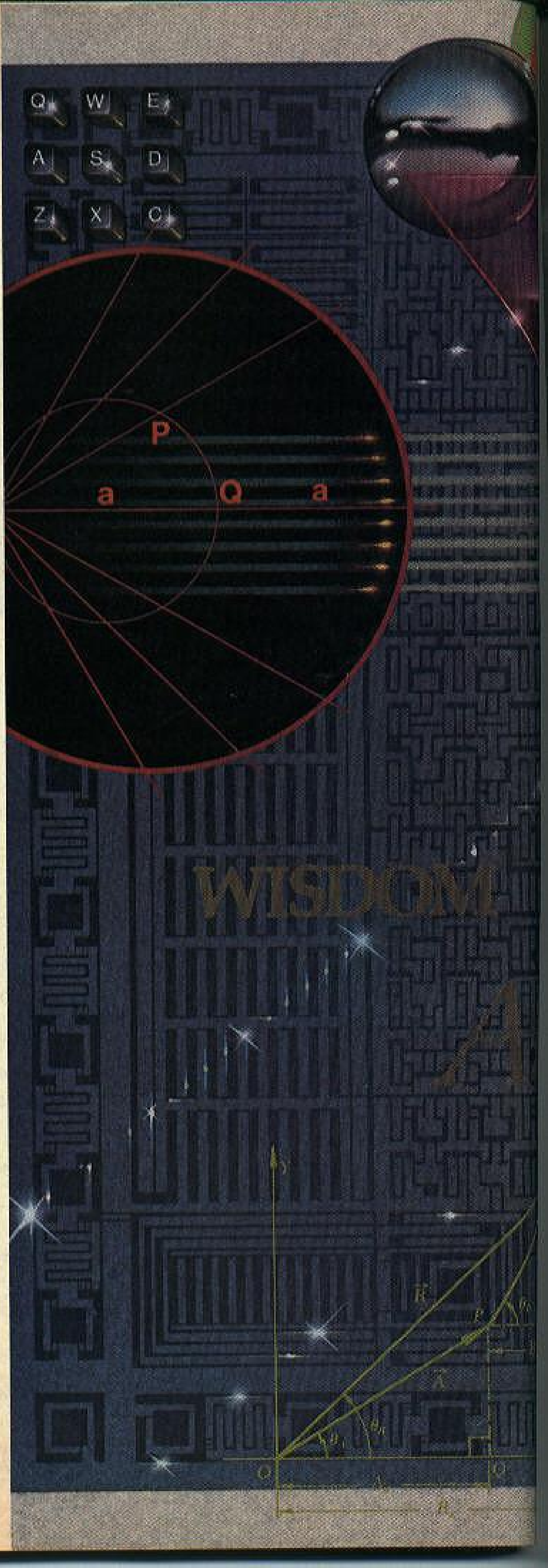

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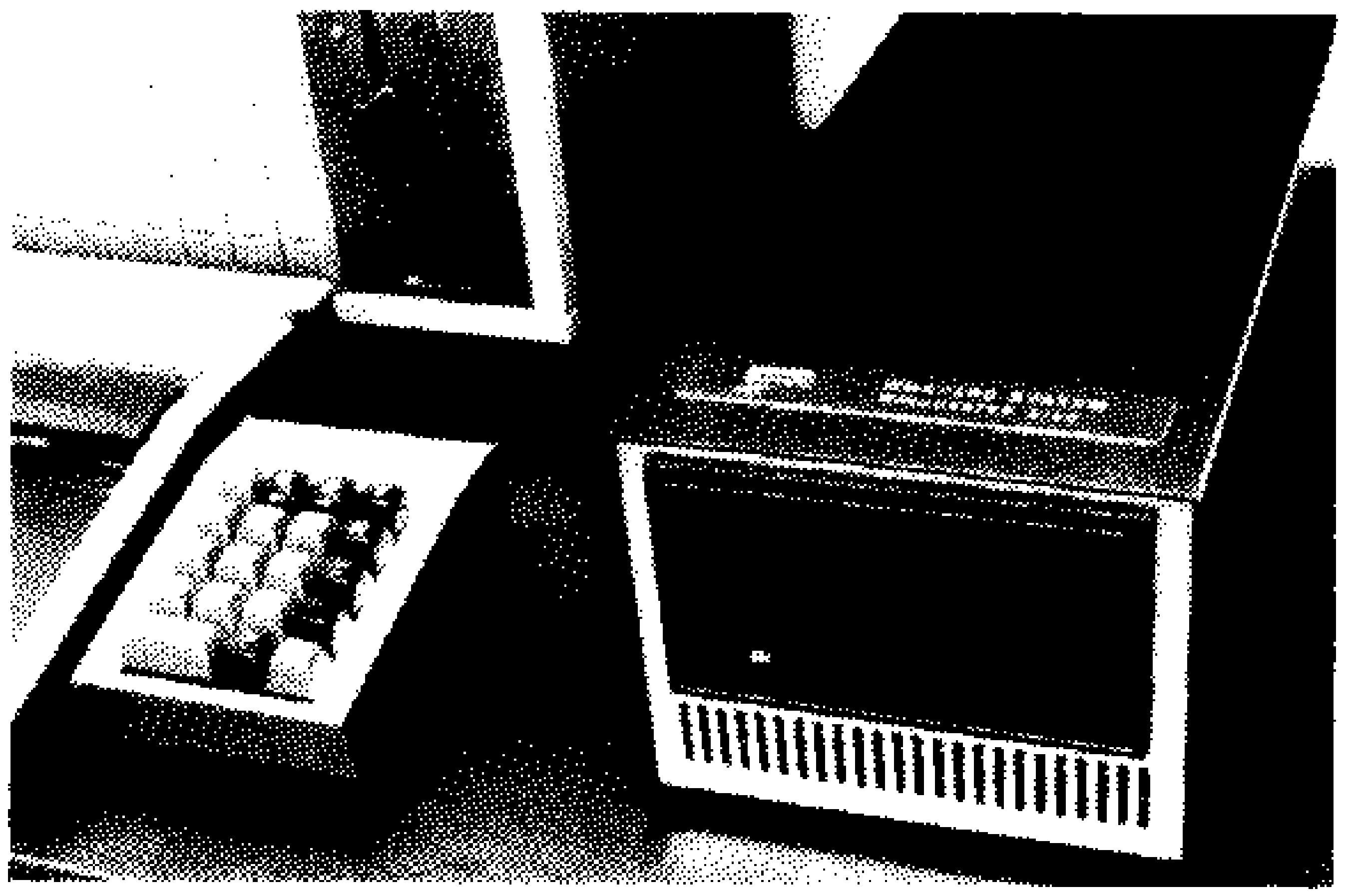

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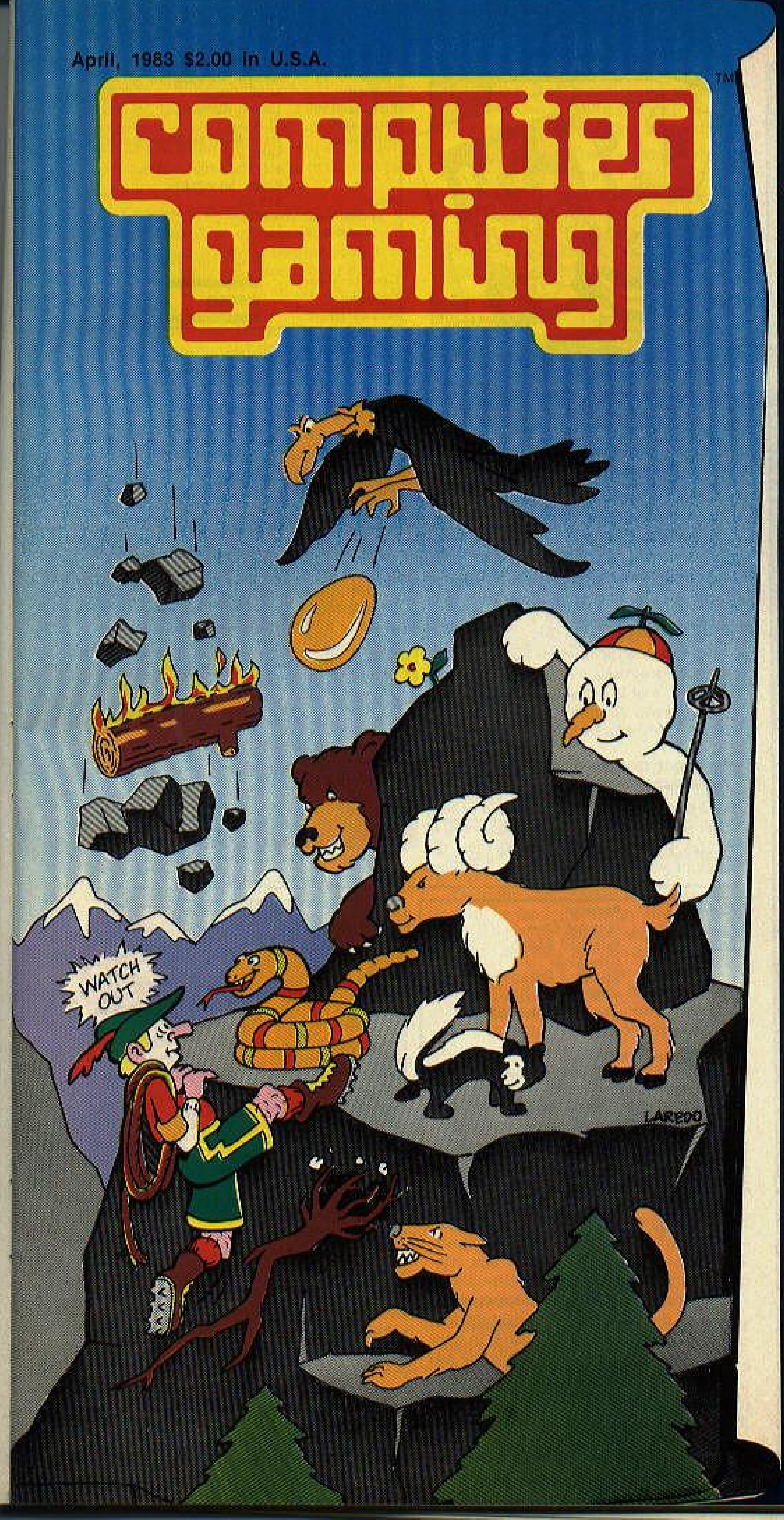


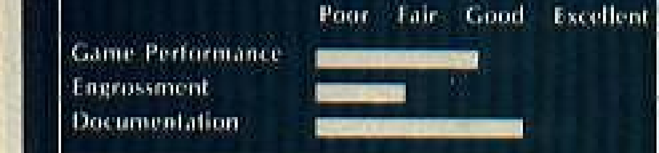
ARCADE PEAKS

A Review of Alpiner

By W.K. Balthrop
Technical Editor

Name:	Alpiner
Type:	Climbing Arcade
Language:	Assembly/Cartridge
Author:	Janet Srimushnam
Distributor:	Texas Instruments P. O. Box 53 Lubbock, TX 79408
Price:	$39.95

System Requirements
- TI-99/4A
- Wired remote controllers (optional)
- Speech Synthesizer (optional)



There's a stiff chill in the air, and smoke is pouring from the chimney of your cabin behind you. Before you stands a challenge that would turn the stoutest of hearts to Jello. You are about to climb one of the world's tallest mountains. You will confront a variety of vicious wild animals and natural disasters as you make your perilous journey.

Alpiner is part of a new variety of arcade-type "climbing" games. The Solid-State cartridge released by Texas Instruments requires nothing more than the bare console and a lot of wits. The speech synthesizer is highly recommended, but like the joysticks, it is optional.

Either one or two people can play *Alpiner*. Each person takes a turn, continuing until they either reach the top, or lose all their climbers. There are six mountains to master, each one higher than the next. Through the first six climbs you must dodge trees, stumps, and brush fires—not to mention bears, mountain lions, rams, vultures, and even bats. The grand climb comes for the first time on level six, with Mount Everest. After level six, you start all over with the first mountain—only this time the trip will be much more perilous.

Graphics: *Alpiner's* graphics are fairly imaginative, yet fall short in an attempt to portray realism. For example, your climber does bend his legs and grab with this arms convincingly as he scales the peaks, but you can also occasionally see right *through* him. The sprites for the climber's limbs were not painted solidly, so you can often see the Matterhorn where an arm or leg should be. An even more disconcerting feature is his tendency to split in two as he is wrapping the screen. It may serve to confuse the lion who is stalk-

Continued on p. 26

Computer Gaming™

Computer Gaming is a magazine for all game lovers—players, designers, and programmers of microcomputer games. Regular features include product reviews, letters to the editor, player strategy, a question and answer forum, a Hall of Fame for high scorers, tutorial articles on game design and programming, plus interviews with professionals in the world of computer gaming.

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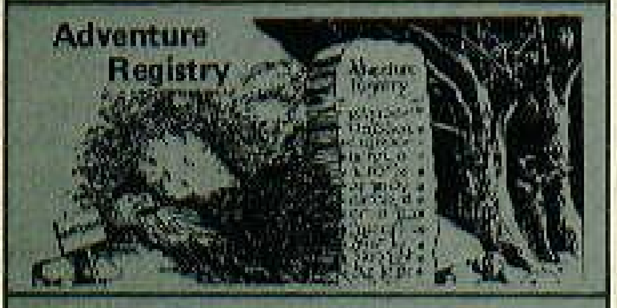
Game Review Criteria

Game Performance measures how well the game responds to the player's commands, rates the quality and realism of the graphics and animation, and examines how well the sound effects, music or speech are integrated into the game. It also determines whether the game delivers what is promised in its advertisements.

Engrossment focuses on that intangible quality that holds the player on the edge of his seat while the hours tick by unnoticed. The game's *staying power* is also assessed.

Documentation rates the printed matter that comes with the game. It notes whether the instructions are clear, comprehensive and easy to use, whether the machine configuration requirements are spelled out, and looks for such information as how to load the program, use the keyboard, and restart the game.



Strategy Corner

99'er Hall of Fame

Casino Royale

A Review of Atlantic City Games

By Walter Hego

Contributing Editor

"Gentlemen, place your bets . . ." You needn't be a tuxedoed gentleman from Monte Carlo or a glassy-eyed veteran of Vegas to win big in *Atlantic City Games*. My card playing experience was limited to Old Maid and 52 Card Pick-up, and even I managed to garner a few chips with this offering from Jerseyware Microcomputer Software. The package promises "Atlantic City style payoffs," and in one sense, it's true—you get two games, *Atlantic City Blackjack* and *Atlantic City Slot*, for the price of one.

Atlantic City Blackjack

The modus operandi of *Atlantic City Blackjack* is about what you would expect: After selecting the size of your bankroll (4 choices from $500 to $10,000) and the range of your betting amounts, a "Place Your Bet" flashes against the green felt table background. Two cards are then dealt to both you and the dealer. Your cards are both face-up, but the value of one of the dealer's cards is concealed. As in a regular game of blackjack, you proceed to either *hit* or *stand* until you are either close to 21 or *busted*. If you grew up sheltered from the evils of card parlors, you needn't worry about tallying your cards' points correctly. The program automatically displays your score each time you are hit.

Once you stand, it is the dealer's turn. Unfortunately, your opponent is not quite "playing with a full deck." He will always hit if his total is 16 or less, and stand if it is 17 or more. (Actually, I might have done better, adhering to that formula.) The winner is announced, your score is adjusted, and you play again.

Features: *Atlantic City Blackjack* boasts three extra features which let you add a bit more strategy to your game. You have the option to *double down* (double your wager and agree to draw only one more card), *split pairs* (double original wager, and play

Continued on p. 27

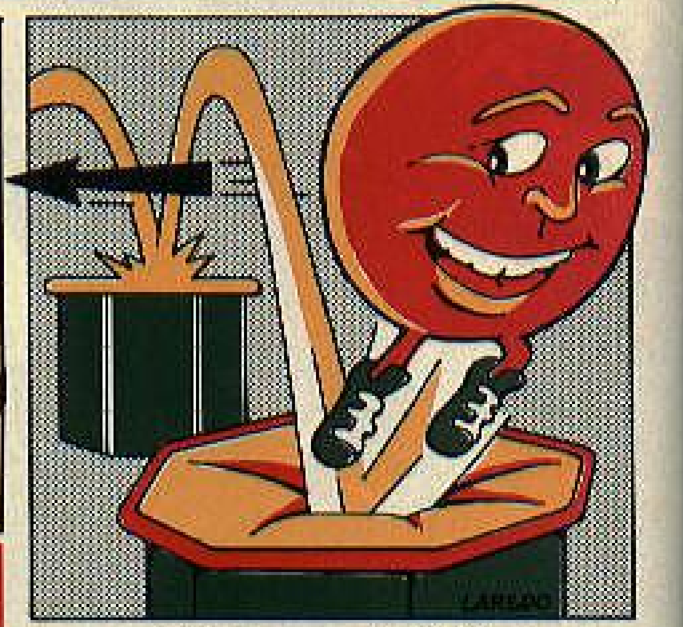
Name: Atlantic City Games
Author: Mike Lavdas
Program Type: Casino Game
Language: TI BASIC
Distributor: Jerseyware Microcomputer Software
P.O. Box 482
Fords, NJ 08863
Price: $15.00
System Requirements:
Cassette recorder

	Poor	Fair	Good	Excellent
Game Performance	▬	▬	▬	
Engrossment	▬	▬		
Documentation	▬	▬	▬	▬

Name: Bouncer
Program type: Jumping game
Language: Extended BASIC
Author: Greg Kean
Distributor: Extended Software Company
11987 Cedarcreek Drive
Cincinnati, OH 45240
Price: $15.00
System Requirements:
Extended BASIC cartridge, joysticks

	Poor	Fair	Good	Excellent
Game Performance	▬	▬		
Engrossment	▬	▬	▬	
Documentation	▬	▬		

Red Ball Flyer



A Review of Bouncer

By Greg Roberts

99'er HCM Staff

Most arcade games are designed to show your input as lightning-fast blips and instant displays. In some games, however, you have to hang fire and anticipate the course of action in order to compensate for a program that may be slow and meandering. *Bouncer* is such a game.

A red ball bounces from one space to another in slow arcs, and you must plan your shots carefully to protect the ball from a continuous onslaught of arrows. The delayed response also takes some getting used to. In any case, the game must be played with joysticks because it has not been designed to work with arrow keys. Although TI joysticks will work with this game (albeit very poorly in the corner directions), it is easier to maneuver the 45° angles with some of the third-party joysticks that are available.

Graphics: Once you accept the challenge of this kind of play, you will find it an additional pleasure to work with the game's graphics. Although the screen is simply configured in an arrangement of octagon-shaped pedestals or "trampolines," the layout and three-dimensional quality is quite pleasing. There are six levels of design in all, and each requires a different strategy.

Command Response: The object of the game is to clear off all the octagons by touching each with your bouncing ball. If you first touch the center space marked by a black spot, you are charged up for scoring extra points when you reach the outer targets marked with red. To get there without taking an arrow in the belly, however, will call for some planning. Chances are that all five of your "bouncers" will meet the same fate as General Custer, and you will have to start over.

Sound: The sound effects are understandably limited (too many sound statements could slow down a game written in Extended BASIC), but they are adequate for the job.

Documentation: The instructions I received with my copy of *Bouncer* were little more than a short summary of the game. The manufacturer assures us, however, that complete instructions with details on how to load and run are currently in the works and will be included with the game.

Summary: If you're not one to get discouraged easily, you will appreciate the challenge of this game. It takes much practice to let the arrows pass in order to make your move—but eventually you may come to that soul-stirring moment when you confront the sixth pattern. Those who have seen it certainly must comprise a very select club.

A Review of TI Toad

By Judy Sanoian

99'er HCM Staff

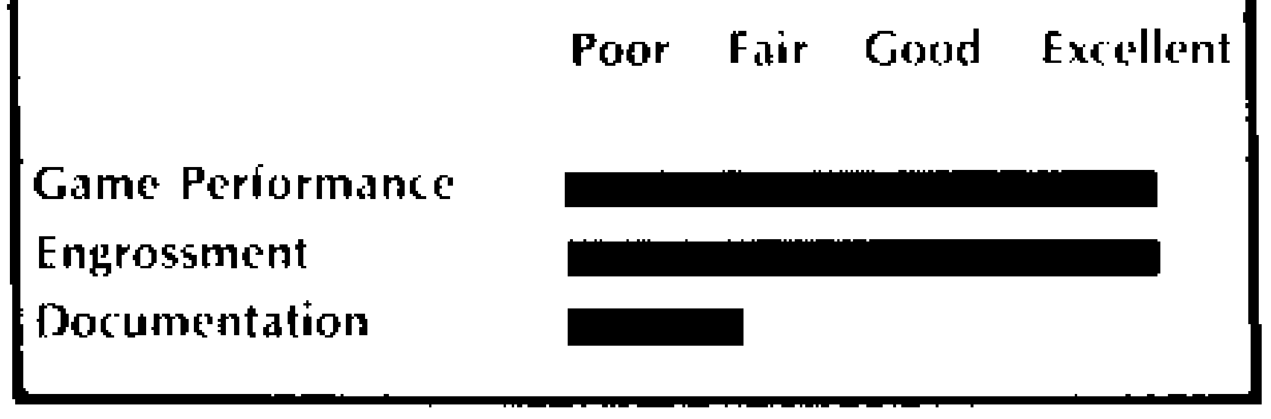
Picture an urban toad, tired of life in the fast lane, trying to hop his way back to the old pond. Imagine this ambitious amphibian executing a series of grand jetés across four lanes of rush-hour traffic, only to face a fast and treacherous river which he must cross by leaping log to log. One false jump and he's an hors d'oeuvre for a water moccasin.

TI Toad, from Software Specialties, Inc., offers just this scenario. After selecting either joystick or keyboard play, and listening to a catchy little tune, you will see your screen fill with four lanes of blacktop jammed with two-way traffic, a rushing river crowded with floating logs, and safe toad havens that await on the other side (except when inhabited by a roving alligator).

The first of your five toads will hop into place and poise for take-off. This plucky ex-polliwog can hop in four directions—up, down, right, left—to avoid the careening cars. It pays to limit the downward and side action, however, as you are also battling the clock. If your time runs out just as you reach toad heaven, you will have a happy toad, but no points; if it runs out *before*, you will have a *dead* toad on your hands . . . . I found the best strategy was to look for a break and zip straight across—*fast*.

Name:	TI Toad
Program Type:	Frog Jump Type
Language:	Assembly
Author:	Glen H. Groves
Distributor:	Software Specialties, Inc. Box 18051 Denver, CO 80218
Price:	$29.95

System Requirements:
Disk drive
Extended BASIC
Expansion Memory



Once the little croaker has traversed the traffic, he faces the mighty river. There is something a bit strange about the river's current—the logs are flowing fast in *both* directions. Don't let this disorient you, though; your timing must be precise as you bounce from one log to the next. Your toads belong to a mutant species of amphibian, and if they fall into the water they will drown. Also, don't let any moss grow on those webbed feet as you sail down the river. If your log goes off the screen, it will not wrap—resulting in another lost toad.

When you reach the last row of logs, your toad is ready to hop on home. There is a bit of strategy to selecting your toad's resting place. If you have some extra time on the clock, you may want to ride out to one of the ponds at the edge of the screen. Once you are near the edge, it takes some slick maneuvering to catch the last log and jump home before you go off the screen.

Command Response: *TI Toad's* strongest point is that it is a hopping good action game. The obstacles are many and challenging, and the player response is quick. You, in turn, must be fast and aim carefully. (I preferred the joystick to the keyboard for this type of

Continued on p. 26

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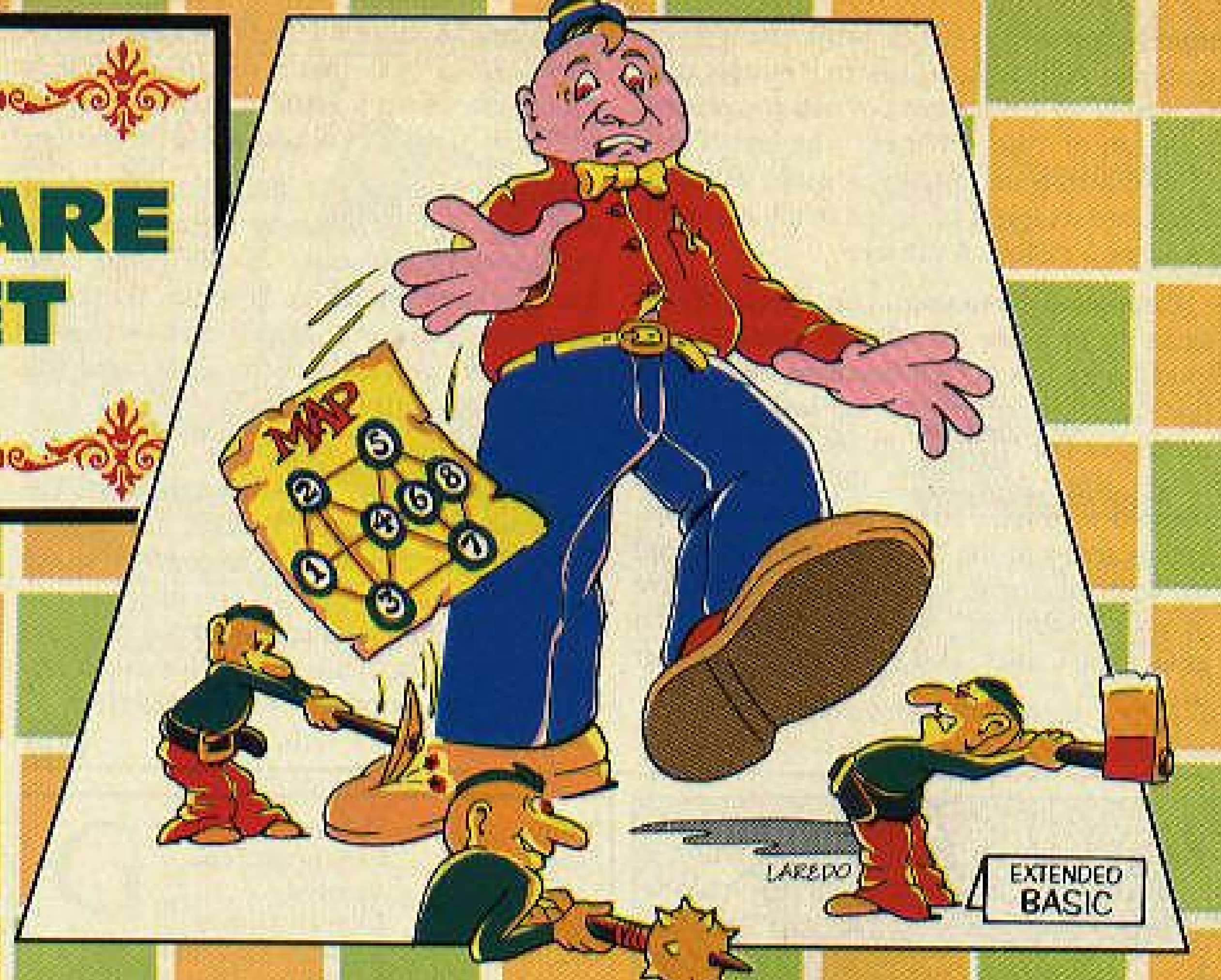
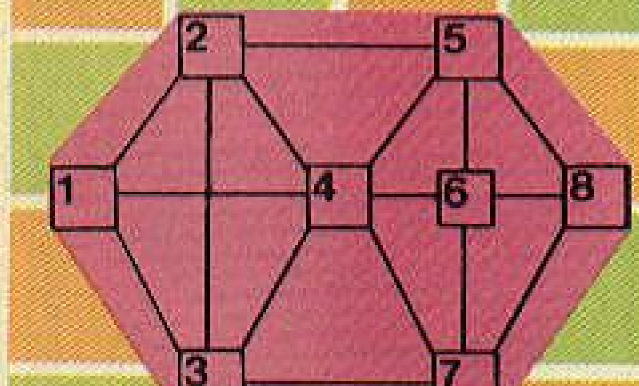


GIANT & DWARFS

By Barry A. Traver
552 Seville Street
Philadelphia, PA 19128

Long ago the Kingdom of Ogrewoerd was inhabited entirely by dwarfs. They lived peaceably until one severe winter, when a giant came down to the dwarfs' valley and started to prey upon their sheep. The dwarfs held council and decided that the three strongest among them should try to drive the giant into a trap—then make him stand trial for fleece filching and lamb larcency.

Giant and Dwarfs is a Dutch "entrapment" board game, beginning with the three dwarfs on the left side of the board and the giant on the right. The three dwarfs can move to any adjacent position, except those behind them. The giant can move one position in any direction.



Don't let the simplicity of the board fool you. Whether you play on the dwarfs' side or the giant's, you may be surprised to find the computer beating you nine times out of ten. It is the duty of the dwarfs to trap the giant in position 8 with the dwarfs in positions 5, 6, and 7. If they can do this, the dwarfs win. If the giant succeeds in getting past the dwarfs, he will be victorious. If the giant gets caught in a stalemate—with both sides repeating the same moves over and over—the giant is the winner. After all, he has more stamina than the little dwarfs.

The game starts by offering to show you the instructions. Then the main selection screen comes on. Here you can select one of four options. Simply press your choice, without using the Enter key. Option 1 lets you play the giant, while the computer takes the part of the dwarfs. In option 2, the computer is the giant. Option 3 lets two people play with no computer intervention (except for checking illegal moves, and determining the winner). Option 4 can be used only after you have played options 1 and 2 at least four times each. In this mode, the computer plays itself and you can see how it sets up a strategy. For those who just can't resist cheating a little, a fifth option lets you see the strategy without having to wait. I'll let you figure out how to access it; after all, it wouldn't be fair to give away all my secrets. If you have chosen options 1 or 2, the computer will keep and display a running score for the both of you. Even if you change sides, your score stays with you.

Illegal moves include taking a position non-adjacent to your piece, taking an occupied position, moving from an unoccupied position, or moving a dwarf backwards. During the game you may read the rules simply by pressing 0. To choose a new option, press 9.

EXPLANATION OF THE PROGRAM
Giant and Dwarfs

Line Nos.	
100-160	Program header.
170-180	Display title screen.
190-270	Initialize variables.
280-360	Define graphics characters.
370-400	Input option to display the instructions.
410-460	Control loop for displaying instructions.
470-630	Display option menu, and input choice.
640-740	Control loop to play the game.
750-870	Move pieces.
880-1110	Input move, display it, and check it.
1120-1150	Update position.
1160-1360	The computer calculates the giant's move.
1370-1640	The computer calculates the dwarf's move.
1650-1710	Computer takes first move for the giant.
1720-1830	End of game. Display scores.

Continued on p. 56

BOA ALLEY

By Tarik Isani

601 Alleghany Street
Blacksburg, VA 24060

Here I am, minding my own business—poking around for food. It's a hot day, so I think I'll try checking out some of the local caves. That's odd—the entrance to this cave is strangely square, and the sides of this hill go straight up and down. Oh well, maybe I'll find something special, like a lizard egg, or a juicy young mouse. Inside, I see many pillars from the floor to the ceiling. Suddenly the light from the entrance disappears. The sun can't be setting already—I'm still hungry. Checking out the entrance, I find it's been blocked, probably by one of those big ugly creatures that are always yelling and trying to step on me. I'd better find some food fast; this long body of mine needs all the nourishment it can get. Boy, it sure is cramped in here; a snake could get himself all tangled up without even trying. Ah! There's some food. I can smell it. Now, if only I can reach it before I tie myself in knots.

The Game

Boa Alley is a game written in TI BASIC. The object is to maneuver a long snake under a house and around the foundation posts. Should the snake touch either the posts or the walls, he will come in contact with wood preservatives and die. If the snake runs over himself, he will become hopelessly entangled around the foundation. To score, you must direct your reptile to food sources. A new piece of food will appear every time the snake eats something. This is not as easy as it sounds.

The snake is very long, and maneuvering becomes difficult. You can use either the keyboard or joystick to direct the snake, which keeps moving—so stay on your toes to keep from getting entangled.

The game is surprisingly fast. The first section of the snake is added and the last section is deleted in order to simulate movement, meaning you have to make split-second decisions in making your turns. Stay alert: The snake is not going to wait for you.

LAREDO
TI BASIC

EXPLANATION OF THE PROGRAM
Boa Alley

Line Nos.	
100-160	Header REM statements.
170-190	Clear screen and set screen color to black.
200-250	Print instructions.
260-280	Initialize color for characters sets.
290-300	Wait for a key to be pressed.
310-400	Display message, and input decision to use joystick or keys.
410-580	Initialize colors and character patterns.
590-810	Display playing screen.
820-1260	Display snake.
1270-1330	Place food on screen.
1340-1500	Read keyboard.
1510-1540	Read joysticks.
1550-1640	Check limits for a valid move.
1650-1760	Snake dies. Prepare for new game.
1770-1910	Move snake.
1920-1950	Subroutine to display a string variable without scrolling.

```
100 REM  *************
110 REM  * BOA ALLEY *
120 REM  *************
130 REM  BY TARIK ISANI
140 REM  99'ER VERSION 2.6.1
150 REM
160 REM
170 CALL CLEAR
180 CALL SCREEN(2)
190 RANDOMIZE
200 PRINT "      *** BOA ALLEY ***"
    ::"            BY":"        TA
    RIK ISANI"
210 PRINT :"YOU  MUST  DIRECT  A
     LONG"::"SNAKE-LIKE  OBJECT  T
    HROUGH"
220 PRINT :"A MAZE  HITTING ROUND
    WHITE"::"TARGETS.  USE THE  JO
    YSTICK"
230 PRINT :"OR THE ARROW  KEYS TO
    MOVE."::"IF YOU  HIT  YOURSELF
    ,  THE"
240 PRINT :"BOUNDARIES OR THE DIVI
    DERS,"::"THE GAME WILL END."
250 PRINT :"[PRESS ANY KEY TO CONT
    INUE]"
260 FOR I=1 TO 8
270 CALL COLOR(I,16,1)
280 NEXT I
290 CALL KEY(0,S1,S2)
300 IF S2=0 THEN 290
310 CALL CLEAR
320 FOR I=1 TO 8
330 CALL COLOR(I,1,1)
340 NEXT I
350 PRINT :"   METHOD OF INPUT:"::
    "      1. ARROW KEYS"::"      2.
     JOYSTICK"::::
360 FOR I=1 TO 8
370 CALL COLOR(I,16,1)
380 NEXT I
390 CALL KEY(0,O1,O2)
400 IF (O1<49)+(O1>50)THEN 390
410 CALL CLEAR
420 FOR I=2 TO 9
430 CALL COLOR(I,2,9)
440 NEXT I
450 CALL COLOR(9,10,1)
460 CALL COLOR(11,14,1)
470 CALL COLOR(12,16,1)
480 CALL COLOR(13,5,1)
490 CALL COLOR(14,9,1)
500 CALL CHAR(96,"3C7EFF9999FF7E3C
    ")
510 CALL CHAR(97,"3C66E7FFFFE7663C
    ")
520 CALL CHAR(112,"007E7E66667E7E0
    0")
530 CALL CHAR(120,"3C7EFFFFFFFF7E3
    C")
540 CALL CHAR(129,"183C7EFFFFFFC38
    1")
550 CALL CHAR(132,"F87C3E3F3F3E7CF
    8")
560 CALL CHAR(131,"81C3FFFFFF7E3C1
    8")
570 CALL CHAR(128,"1F3E7CFCFC7C3E1
    F")
580 CALL CHAR(136,"FFFFFFFFFFFFFFF
    F")
590 OPTION BASE 1
600 DIM P(105,2)
610 CALL HCHAR(1,2,136,29)
620 CALL HCHAR(23,2,136,29)
630 CALL VCHAR(1,2,136,23)
640 CALL VCHAR(1,30,136,23)
650 FOR I=3 TO 21 STEP 2
660 FOR J=4 TO 20 STEP 2
670 CALL VCHAR(I,J,112)
680 NEXT J
690 NEXT I
700 Q=1
```

Continued on p. 37

WIZARD'S DOMINION

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TI TOAD

. . . from p. 23

split-second action.) Your speed determines both your score and your survival.

The game offers several levels of difficulty. After you get all five toads across, you progress to screen two (with undulating starfish in the river and faster cars), then screen three (with turtles and speeding police cars), and then screen four (as far as I got . . .), which displays bright red lobsters and race cars. While *TI Toad* is not a game you will master *instantly*, it probably won't take long before your toad is hobnobbing with the turtles and lobsters on a regular basis. The game's response is quick enough to let your toad dodge the cars artfully, once you get down the timing. At the same time, the increasing speeds on each level ensure the game will remain a challenge long after the "initial game thrill" is gone.

Documentation: Unfortunately, you'll have to rely solely on experience to reach those higher levels. The game's documentation is a short, two-paragraph instruction sheet, which offers little helpful advice or explanation. It doesn't even tell you what equipment is needed to run the program, let alone offer any playing tips.

Graphics: I found the game aesthetically pleasing. The graphics are colorful and imaginative, especially as you reach the higher levels. I was particularly fond of screen four's lobsters with snapping pincers, and flashing police cars. All in all, the game designer made very effective use of animation and color.

Sound: The game's sound effects are also good—a satisfying "boink" for the hops and dunking noises when your toad falls in the drink. And you'll have some trouble getting the catchy TI Toad jingle out of your head. I found myself humming it for days.

Summary: Anyone familiar with computer games knows that *TI Toad* is just one of several "frog-crossing-the-road" type games. I found that it compared favorably with any of these, even the arcade version. *TI Toad's* player response, action, and graphics are right up there with the best of them. I can't help wondering, though, why there are so *many* similar frog-survival games. Do we really need *TI Toad, Froggy, Froggie*, and *Frogger*? Obviously, it's because game players are jumping to buy these games. No one can deny the scenario is a winner, but how about a little *variation* on the theme? In the meantime, I'll be among those leap-frogging the commuters with my *TI Toad*.

[Note: See *Third-Party News* concerning the use of the trademark initials "TI" on page 59 in this issue—Ed.]

ALPINER

. . . from p. 21

ing him, but it's hardly a realistic effect. To simulate the climbing movement, the mountain slope scrolls downward. It is not very convincing but you do get used to it.

There are numerous obstacles to avoid, including rock slides, avalanches, icefalls and wild animals, some of which carry jewels worth extra points if you can snatch them. These are significantly less animated and realistic than the climber. The avalanches, icefalls, and rock slides, in particular, would seem to warrant some spectacular graphic effects. There's also an abominable snowman to contend with if you're lucky enough to make it to the top of Mount Everest in levels 6, 12, and 18. He was, however, a big disappointment. After playing for hours to finally reach Everest's summit, the creature appeared as a friendly *snow* man—wearing a cute little red beanie. It made me wonder if this was a joke, or if the game's designers were simply too out of touch to realize that the abominable snowman is actually a big, hairy monster. Whatever the case, the snowman will catch you and throw you down the mountain if you let him.

Speech: The speech is, in fact, one of the best features of the cartridge. The computer uses a female voice to make helpful suggestions to the game player; the male voice comes from the climber responding to the action. It's quite a novelty to hear two voices responding to your play with such phrases as: "Look out . . . Ouch . . . Yuck . . . Did you do that on purpose? . . . Not as easy as it looks . . . " Unfortunately, the speech is not carefully integrated with the play. The warnings are not always in time, and after a while, the constant chiding and sarcasm may grate on your nerves.

Command Response: *Alpiner* is easy to learn. Whether using the eight directional keys

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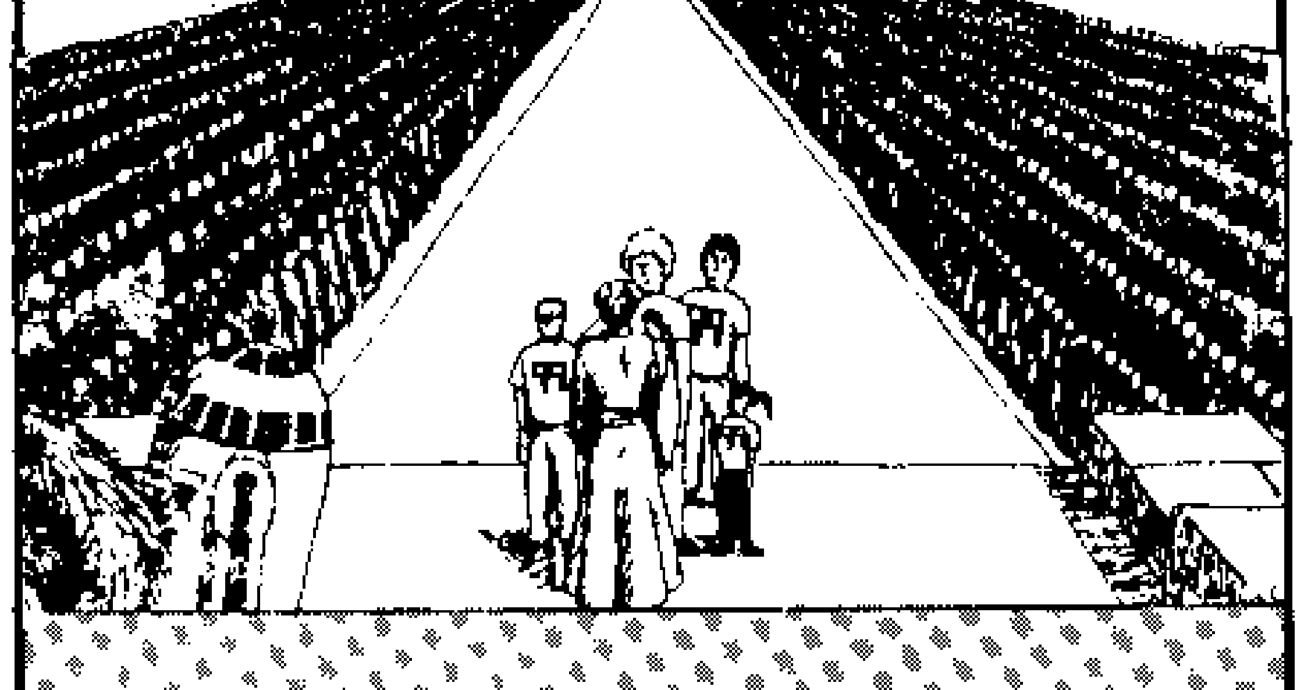


Name: Amber Dawn Elledge (Springfield, IL)
Game: TI Invaders
Score: 23,012

Name: Cody Collins (Arlington, TX)
Game: Parsec
Score: 1,312,600

Name: Bill Richard (Chesterson, IN)
Game: MunchMan
Score: 191,970

Name: Tom Wynne (Edmonds, WA)
Game: Tombstone City
Score: 1,009,600

Name: Glynn Johnson (Houston, TX)
Game: Car Wars
Score: 26,090

Name: David D. Gray (Colorado Springs, CO)
Game: Henhouse
Score: 38,810

or the joystick, you simply move the climber up, down, left, or right. You can also move diagonally in any direction, and you may find the keyboard easier for that type of movement. In addition, there is an identical set of movement keys on both the left and right sides of the keyboard so that left-handed people can stand the same chance for survival. If you need to take a break during the game, press either "P" or "T" keys for a time out. To resume, simply press any other key. To start a new game, press FCTN 8 (REDO); or, to turn to the menu selection screen, press FCTN 9 (BACK).

According to the manual, on some consoles a falling climber may flash on the right hand side of the screen for an instant. I did not, however, see this happen. The climber will wrap the screen on the left and right, which makes evading falling obstacles easier—and because the climber himself does not move vertically, there is no wrapping at the top or bottom.

All in all, I was a little disappointed by the action of the game. The beginning was so simple, it was almost boring. Then, all of a sudden, you are thrust upon Mount Everest where the difficulties seemed to triple. It took me quite a few tries before I was able to get to the seventh level—although I always managed to make it to the sixth. From the seventh level on, the game becomes almost impossible. Somewhere around the 10th or 12th level, the rock slides, avalanches, and icefalls always come directly from above your head. If there's any way to avoid getting clobbered, I would like to know it.

Music: Another unsettling feature is the background music. *Anitra's Dance* by Grieg is a catchy little tune, but after you've heard it repeated a hundred times, it starts to get on your nerves. You may remember young Alec in *A Clockwork Orange*, who was forced to listen to his favorite Beethoven symphony a few times too many: he finally jumped out the window.

Documentation: Consistent with all TI manuals, the 18-page booklet is well-written and easy to understand. Full instructions describe the wildlife and obstacles, and tell how to control the climber. Also included is a detailed section showing how the scores are accumulated for each of the six mountains.

Summary: The disappointing parts of the program are its uneven flow of difficulty and the unrelenting monotony of the music. The quality and realism of the graphics also failed to satisfy me. And it would have been nice to offer the climber some way to hang on or otherwise avoid obstacles. Nevertheless, if you are a person who accepts a challenge head on without getting frustrated easily, this may be just the program for you.

ATLANTIC CITY . . . from p. 22

each of your two cards as new hands), or—if the dealer's exposed card is an ace—take out *insurance* to halve your losses (or similarly reduce your winnings).

Documentation: The game's documentation is comprehensive and easy to understand. There are step-by-step instructions for how to load the game and a detailed explanation of how to play. The rules of blackjack are included for those who have never played before, and common playing errors are noted.

Graphics: I do have some reservations about the game. Its graphics are strictly run-of-the-mill. Of course, there's only so much you can do with playing-card faces, but I would have enjoyed some sort of hoopla when I hit blackjack or a visual moan when I busted. I also rather resented the maximum bet limit—as if I were a compulsive gambler about to blow the family savings. And I wonder if it is necessary to automatically total the cards' points. Without this feature, the kids could get some addition practice. Finally, hard core card sharks might complain about the short wait before you place each new bet.

Despite these minor complaints, I found *Atlantic City Blackjack* quite an entertaining little game. It is easy enough for a beginner to enjoy right away, while its extra features offer a challenge for the blackjack sharpie.

Atlantic City Slot

On the flip side of the cassette is a slot machine game, *Atlantic City Slot*. This is a very simple game that even young children can master. A slot machine appears on the screen after you set the amount of your starting money. All you do is decide how much money to risk, pull the handle, and watch the money grow (or dwindle).

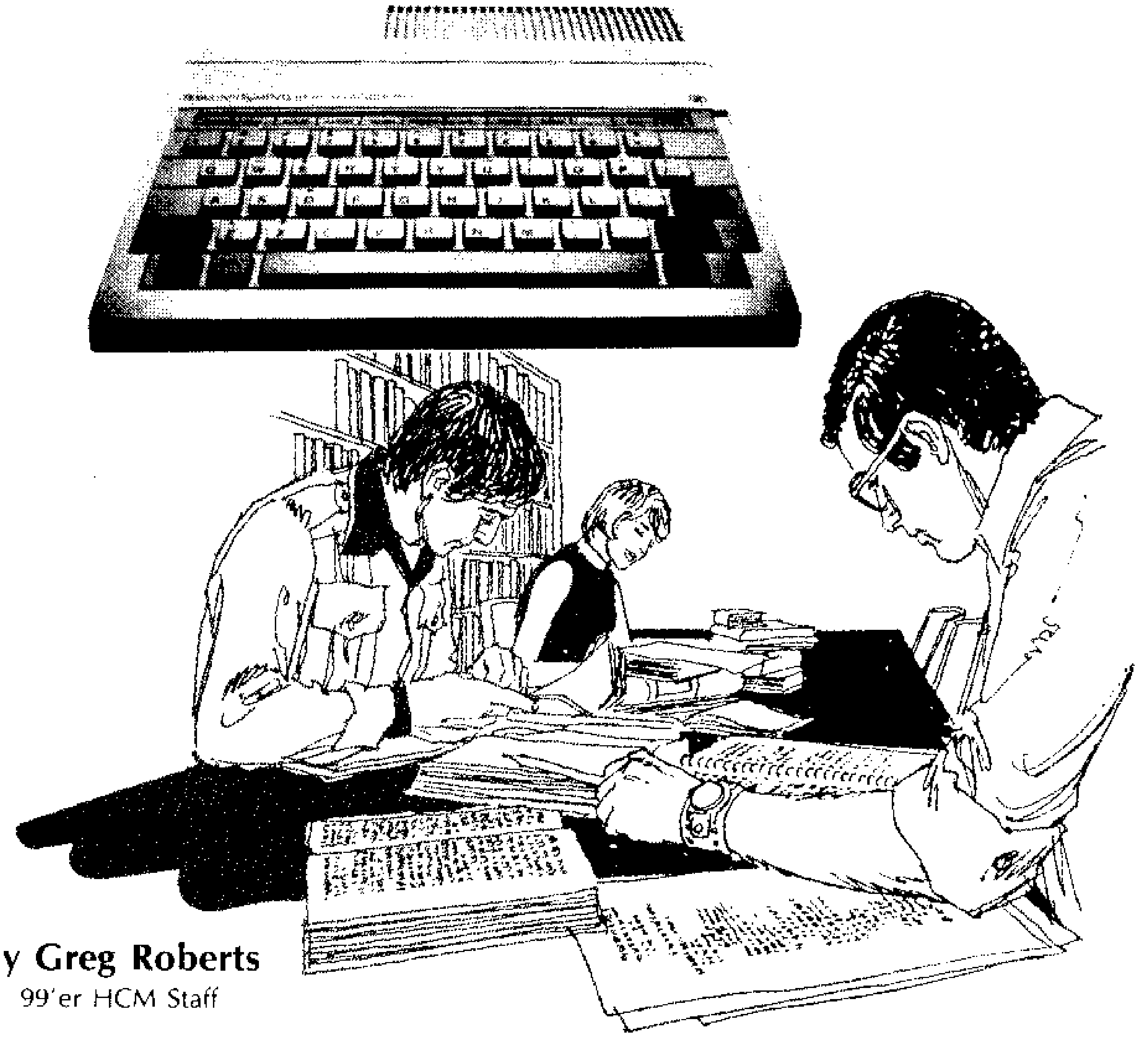
I can't imagine this game holding an adult's attention for long—unless the thrill of watching the growth of an imaginary cash pile holds enormous fantasy appeal.

Compared with some of the fancier cartridge slot machine games on the market, *Atlantic City Slot* looks fairly primitive. You should bear in mind, however, that it offers the same basic slot machine game (sans elaborate graphics and sound effects) at a significantly lower price. As with *Atlantic City Blackjack*, I think the game's designers missed the opportunity to build an educational (arithmetic) aspect into the game. On the plus side, the game is easy to learn and use, the instructions are complete, and the program performs well.

Considered as a package, with *Atlantic City Blackjack* being the prime draw, I'd say the *Atlantic City Games* offer a strong hand.

B.M.O.C.

Big Machine On Campus



By Greg Roberts

99'er HCM Staff

A university can put up a deceptive facade: the well-tended grounds dotted with ancient, imposing buildings stand for a rich and solid tradition. In an attempt to show that the tradition is being strengthened and modernized, some new buildings of concrete and glass may be sandwiched between the old Greek and Georgian structures. It all looks so complete—everything the students need to develop their minds to the limit. Nevertheless, the school may suffer from appalling deficiencies: The psychology library may carry nothing more recent than the works of Kinsey and Reich; the school orchestra may have to struggle under a part-time conductor deaf in the left ear; and the poet in residence could be a derelict journalist from the local weekly. But perhaps the most blatant affliction of colleges everywhere is the scarcity of computer resources.

The red tape, the long lines, the getting up at 3 a.m. to take the only open slot in the sign-up sheet—all these are symptoms of a common malaise. The situation was bad ten years ago when computers of any kind were expensive. And now, even the gains made by an increase in school machines have been canceled out by the geometric upsurge in the number of students wishing to learn about computers. Computer classes at universities and community colleges are operating in what feels like an emergency atmosphere—as if a flood or hurricane had suddenly stranded thousands outside the doors of the shelter. These students realize that their life's work—whatever it turns out to be—will probably require some kind of computer training.

When and how will these conditions take a turn for the better? The solution is now within the *students'* reach. Consider this scene: Tony's dormitory room is lit up late at night by the glow of a computer monitor. He sits before a shiny keyboard, an open manual on his desk. Out in the parking lot, Jonathan Thorndike III has just parked his Jaguar and suddenly catches a glimpse of the computer light. Intrigued, he heads into the dorm and finds his way to Tony's room. Barely saying hello, Jonathan laughs out loud at the other student's computer, "Why, it's only a toy—some sort of plug-in abacus!"

"I wouldn't say so," answers Tony. "I take my computer work seriously."

"I've got an Apple II with 64K and floppy disks," says the man in the rugby shirt. "I can program in three languages. I'll show it to you sometime. Get back to me and we'll set up an appointment."

Tony presses some keys, and the ten-dollar cast-off TV set from St. Vincent de Paul flashes a mind-tangling display of data. "That's not exactly Donkey Kong up there, either," he says with an elaborate gesture.

Jonathan squints through his robins-egg-blue contact lenses. "FORMAT(17H COMPLEX NUMBER =,F15.3SH. . . .Hey, that's FORTRAN, isn't it?"

"Yup," says Tony, "one of four languages I'm learning on this machine."

"What model is that?"

"The TI 99/2."

"That *can't* be the one they're selling for under a hundred bucks."

"It is for the price of a used ten-speed bike."

Jonathan's expression grows frantic, and out of sheer nervousness, he twists and strips the threads on his Cross pen. "My computer has a color monitor—very high resolution."

Tony pulls a pencil from behind his ear and looks up at Jonathan. "For $4000 you got yourself quite a deal."

Tony's *teacher* for this course is a plug-in cartridge that lets him absorb the language bit by bit—in a method so well-organized, he doesn't really need the manual. And Tony has other tricks up his sleeve. For example, he uses the 99/2 to hook up to major data bases in university libraries. With his Hex-bus modem and a telephone, he can work with theories and formulas stored on mainframes at the top research facilities of the country.

He didn't bother to explain any of this to Jonathan Thorndike III. Tony has no particular desire to see another person squirm and whimper. Besides, Jonathan will find out soon enough: more and more desks in the dormitory will be making space for the small, efficient machines. The students are using the computer to work through complex problems, often touching base with teachers and advisers via a modem and telephone—quite a convenience, considering how difficult it can be to make a personal appointment with busy professors. These possibilities are changing the face of education: In the dormitories of today, the light of the computer screen is starting to take the place of the psychedelic black lights and beer signs of a previous generation.

The need for computer literacy is recognized by all computer manufacturers, of course; but so far, the only computer that can address such a need (because it is both inexpensive and powerful enough for the job) is the TI-99/2. It can honestly claim to take the place of a classroom experience. In fact, considering the hands-on experience instantly available to machine owners, the 99/2 option would seem a clear advantage over sitting in a crowded lecture, and then waiting for limited time at a terminal or

Crossbytes™

Answers to March Crossbytes

A	S	T	E	R	■	G	A	M	E	S
M	E	■	R	■	A	■	L	E	N	T
■	T	H	I	R	D	P	A	R	T	Y
I	S	O	N	■	S	■	■	G	E	■
L	■	L	■	G	■	T	O	E	R	R
■	M	E	M	O	R	I	E	S	■	U
■	A	■	A	T	O	■	■	■	I	N
S	U	B	R	O	U	T	I	N	E	S
O	L	A	■	■	T	U	D	E	■	A
A	S	C	I	I	■	T	E	X	A	S
R	■	H	O	M	E	■	A	T	N	■

1			2	3	4	5	6			7
	■	■	8					■	■	
9	10	11	■	12			■	13	14	
15			16							
17				■		■		18		
19							20			
21			■	■		■	22			
23				24		25				
26			■	27				28		
	■	■	29				30	■	■	
31										

ACROSS

1. Computer enthusiasts may be found doing this day and night.
8. *Munch-Man* takes lots of them.
9. A resident down south where TI's are made might affectionately be referred to as a ———.
12. Garden vegetable that sounds like UCSD system.
13. Tower of Hanoi game started here. (slang form)
15. —— —— ———————— emergency, hospitals can check the computer for available body parts. (3 wds.)
17. Beginners of computer chess will soon find their king ca—————ed by the machine opponent.
18. A church seat spelled backwards—where some computer enthusiasts squirm, waiting to get back to their keyboards.
19. A ——————————— numbering system is commonly used in 16-bit processors.
21. Peripherals air-freighted through this PA lake town may carry the airport code ———.
22. The namesake for the PLATO computer library wore one.
23. When your computer game enemies attack, you must take ——————————— action.
26. Any business bigger than a lemon——— stand could probably make use of *Multiplan*.
27. The big fat program ——— up all the memory.
28. Young person's exclamation of awe, upon trying out a computer.
29. Someday laser technology will —————— a complete encylopedia on one disk.
31. Happening at the same time, as when two computers' operations are controlled by signals from the same master clock.

DOWN

1. They work with, and are accessories to the computer.
2. Initials for that merrie old land which is fast becoming addicted to home computers.
3. The spring software is on the shelf and ———— for plucking.
4. A writer with a computer could make use of one. (3 wds.)
5. TI BASIC might be referred to as the ———— and potatoes programmer's language.
6. —— Swift is the assembly language expert at HCM.
7. Inhabitants of arcades. (2 wds.)
10. Already put in the data.
11. The miner in the *Gold Rush* game could possibly run into this aluminum ore.
13. A music synthesizer fan might well come out of the store with one. (2 wds.)
14. A score of 270 in *Munch-Man* would show that the little guy certainly had — ——————— repast. (2 wds., alternate spelling)
20. Name of a worldwide electronics corporation. (abb.)
24. Matrix for plaster, or diminutive version of mother board.
25. The term "joystick" was coined by pilots back when they referred to their crafts as ————planes.
29. The Charleston users group lives here. (abb.)
30. ——route to the computer room. . .

keypunch machine. The 99/2 training in BASIC, COBOL, FORTRAN, and Pascal can cost less than a course at a community college. And when the students graduate, they not only end up with computer knowledge—they still have their machines!

The 99/2 is a classic example of a manufacturer examining a need in society and then meeting that need with a product precisely tailored for it. But why, instead of inventing a new machine to attack computer illiteracy, didn't TI just continue making more 99/4A's? It appears that TI hopes to widen its market coverage by offering a less expensive instrument without all the niceties of the 99/4A (color, animation, sound, speech, etc.) but which can still provide computer learning for almost anyone. The 99/2 is already down to the price level of a professional-quality slide rule (if such things still exist!), and yet it serves as an interactive teacher of sophisticated programming languages. It is a promising new arrival on a chaotic scene desperate for help.

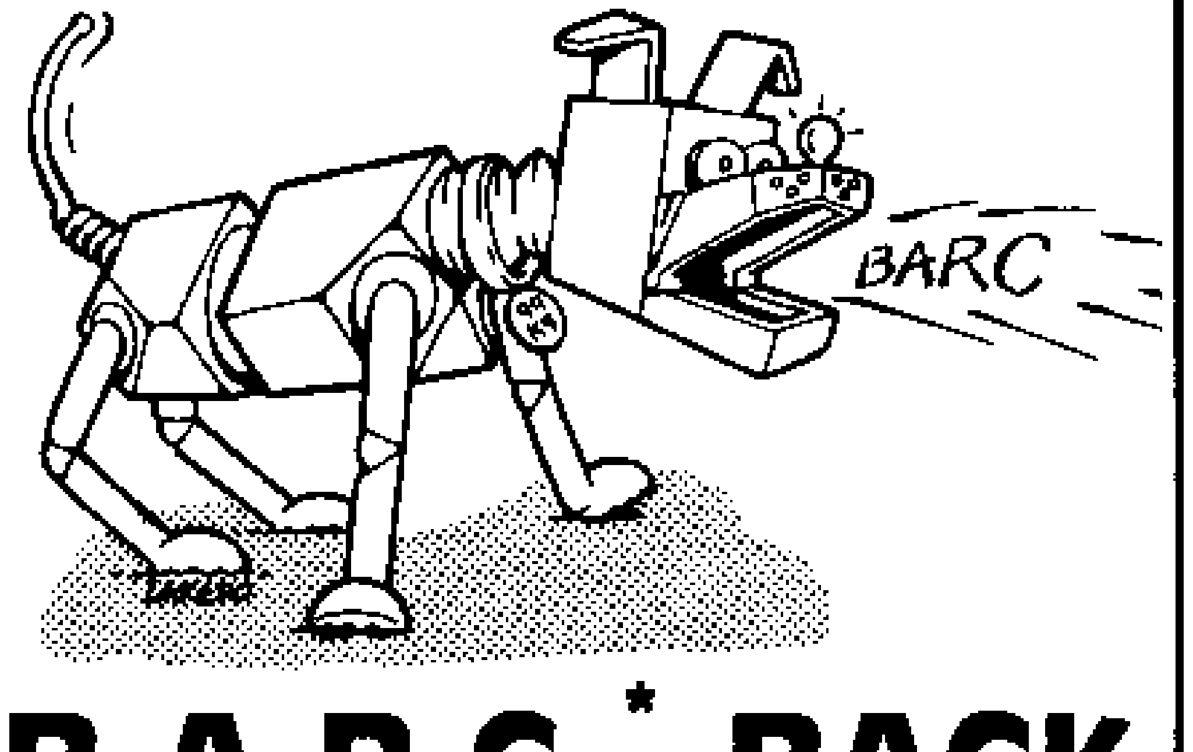
DEBUGS ON DISPLAY

99'er Program Bug

It has come to our attention that part of the *Say and Spell* program listed in the March, 1983 issue was accidentally printed twice. Lines 2190 through 2280 were repeated on the center column of page 23. To enter the program properly, enter lines 2190 to 2280 once. Then, skipping the code which is repeated, continue entering code at line 2290.

The program by Brad Lindsey on page 7 of the March issue's *Letters to the Editor* contained one small typing error. Line 180 STA$= . . . should read 180 STA1= . . .

February's Choice



B.A.R.C.* BACK

***(Best Article—Reader's Choice)**

By popular demand, the winner of the February B.A.R.C. Back competition was Charles M. Ehninger, for his article, *Who Needs a Printer?*. Our congratulations and a $100 prize go to Mr. Ehninger.

COPING WITH COUPONS

SAVE
$
COUPON
COUPON
WITH TI'S PRK CARTRIDGE

By John R. Nichols
77 Symons St.
Richland, WA 99352

In order to get permission to buy our TI-99/4A, I made a lot of promises to my wife. One was that the computer would be used in a crusade to save us money. Specifically, we could create a computerized filing system for our ever-increasing collection of grocery coupons and refund forms.

Well, a year or so passed without a workable system on line. I managed to appease my wife by introducing her to the joys and frustrations of *Munch Man* (she holds the high score of the house). But the shoe box stuffed with coupons was getting out of hand.

I finally was goaded into action by an article by David G. Brader in *99'er* (Vol.1,No. 3) that outlined a practical application for TI's Personal Record Keeping Cartridge. Reading the article helped me realize that this mini-database had all the capabilities for managing a coupon file. But before I descibe how to organize the file, I think a brief essay on the principles of couponing and refunding is in order.

> "Little did I realize that we would soon be saving 23% on our grocery and household items."

Are Coupons Worth the Effort?

We became aware of the savings possible with coupons and refunds when my wife attended an instructional meeting on the subject at our community college. At first I was skeptical. I really didn't believe that any significant savings could come of collecting coupons, filing them, and updating the file.

Little did I realize that we would soon be saving 23% on our grocery and household items. To me, that's significant. And this figure does not include the money from refunds.

We collect coupons from newspapers and magazines, trade with friends and neighbors, and correspond with people from across the country. Even greater monetary benefits can come through refunds.

By sending in proofs of purchase (boxtops, UPC codes, or labels) to manufacturers, you can get cash, free products, valuable cents-off coupons and all sorts of wonderful things. It isn't even always necessary to buy the product that is offering the refund. We cashed in on a $5.00 offer from a candy company by sending in thirty candy bar wrappers that we collected from the local little league park.

Imagine this: Acme toothpaste is on sale at your local supermarket for $1.39 (normally $1.69). You have a coupon worth 25 cents off the purchase price. Also, your store has double coupons that render your coupon worth twice its surface value. You pay only 89 cents for a $1.69 value product. Sound good? Well, let's imagine that Acme will also send $1.00 in return for the UPC code from the toothpaste box. In other words: Acme toothpaste has paid you 11 cents to use their product!

The above example is true. Only the brand name of the toothpaste was changed. This procedure can be followed for many, many products you use regularly. We receive cold cash, checks, free merchandise, and valuable coupons to the tune of $60.00 a month.

For more information on this profitable pastime, attend local classes that explain how to get started, or contact a friend or acquaintance who already knows the ropes. We joined the American Coupon Club (P.O. Box 1148, Great Neck, N.Y. 10023). Their newsletter is a great help, chock-full of good advice, information on offers, classified ads and the like.

You can save big bucks by couponing and refunding, but the paperwork can be a real son-of-a-gun. The biggest problem is keeping track of expiration dates on coupons. Without filing systems, we were letting some real prizes expire on us.

Personal Record Keeping to the Rescue

Our shoebox file is organized according to categories designed by the American Coupon Club (A.C.C.). The fifteen groups are as follows:

1. cereals, breakfast products, baby products
2. dairy products, oils, margarine, diet foods
3. soups, snack foods, candy
4. vegetables, starches, fruits
5. seasonings, sauces, sugar, syrup, salad dressings
6. meat, poultry, seafood, other main dishes
7. baked goods, desserts
8. beverages
9. miscellaneous food products
10. cleaning products, soap, paper products, bags, wraps

11A. health products
11B. personal products
11C. cosmetics, grooming aids
12A. non-food products
12B. pet products

Our 99/4A files are organized alphabetically. Through trial and error, we discovered this method to be the most efficient. We simply scan the listing (see Fig. 3) for the brand and product desired, then extract it from the shoebox file where it is located under the appropriate A.C.C. category. No more coupon-by-coupon searching in the box.

Figures 1 and 2 illustrate the file structure devised for the coupon file. The record widths can be adjusted to the user's preference when setting up the file. We are quite satisfied with this arrangement (see Fig.1). Using this structure will allow 339 pages in the file.

The refund file structure is similiar except for a couple of items. Item 6 is the type of Proof of Purchase (P.O.P) required to cash in on the refund. Item 7 is the number of P.O.P.'s required to qualify.

The refund file can accommodate 273 pages when structured as in Fig. 4.

Maintaining the Computerized File

Correct maintenance of the coupon file requires six steps that should be performed in the order presented here.

The refund file is updated similarly.

Step 1: Update existing coupon quantities in the file (we make notations on the current listing then update the computer bi-weekly).

Step 2: Delete expired and depleted coupon pages from the file. (Start with the highest numbered pages and work down to maintain the integrity of the file.)

Step 3: Add new coupon pages to the file.

Step 4: Reorder the file (ascending order for Brand will provide alphabetical order).

Step 5: Save the updated data file to tape or disk.

Step 6: Print new file listing.

Our coupon file consists of seven tapes with a few categories on each. We currently have over 3,000 coupons.

I haven't gone into great detail on using the Personal Record Keeping Cartridge, because its instruction book is clear-cut and easy to use. The beauty of this cartridge is that it lets users customize the files.

Figure 1

```
                 FILE STRUCTURE
                 --------------

ITEM              TYPE      WIDTH      DEC

1  BRAND          CHAR      10         0
2  PRODUCT        CHAR      8          0
3  CATEGORY       CHAR      3          0
4  VALUE          DEC       4          2
5  EXP. DATE      CHAR      8          0
6  QUANTITY       INT       2          0
```

Figure 2

```
        FILE STRUCTURE
        --------------

      NAME:  COUPONS

      DATE:  4/1/83

ITEMS/PAGE:  6

PAGES USED:  0

PAGES LEFT:  339
```

Figure 3

```
FILE:     COUPONS
DATE:     4/1/83
TITLE:    SAMPLE PRINTOUT

   INDEX
   0 = PAGE #
   1 = BRAND
   2 = PRODUCT
   3 = CATEGORY
   4 = VALUE
   5 = EXP. DATE
   6 = QUANTITY

   0     1             2          3      4      5           6
   ---------------------------------------------------------------
   1     A.JEMIMA      WAFFLES    1      .20    7/15/84     2
   2     A.JEMIMA      SYRUP      1      .25                7
   3     ADORN HR.     SPRAY      11B    .25    12/31/82    3
   4     ARMOUR        HOT DOGS   6      .30                3
   5     BAKER         COCONUT    7      .30                3
   6     CAT CHOW      4 LB.      12B    .25    10/31/82    2
   7     CHEERIOS      CEREAL     1      .24    9/30/83     4
   8     CLAUSSEN      PICKLES    4      .25    5/31/83     1
   9     D.HINES       CK.MIX     7      .30                7
   10    DELMONTE      CATSUP     5      .24                4
   11    DORITOS       CHIPS      3      .25                1
   12    FRISKIES      BUFFET     12B    .12                5
   13    HD&SHOULDR    SHAMPOO    11B    .50                1
   14    HERSHEYS      KISSES     3      .15    12/31/82    2
   15    JOHNSON'S     D.FLOSS    11B    .25    3/31/82     2
   16    KIX           CEREAL     1      .12    10/31/82    3
   17    KRAFT         VELVEETA   2      .50                3
   18    LITELINE      CHEESE     2      .25    9/30/83     1
   19    RAINTREE      LOTION     11C    .30                1
   20    ZACT          T.PASTE    11B    .35    12/31/83    2
```

Figure 4

```
                FILE STRUCTURE
                --------------

ITEM             TYPE      WIDTH     DEC
1  BRAND         CHAR      10        0
2  PRODUCT       CHAR      8         0
3  CATEGORY      CHAR      3         0
4  VALUE         DEC       4         2
5  EXP.DATE      CHAR      8         0
6  POP TYPE      CHAR      8         0
7  POP QTY       INT       2         0
```

Figure 5

```
        FILE STRUCTURE
        --------------

      NAME:  REFUNDS

      DATE:  4/1/83

ITEMS/PAGE:  7

PAGES USED:  0

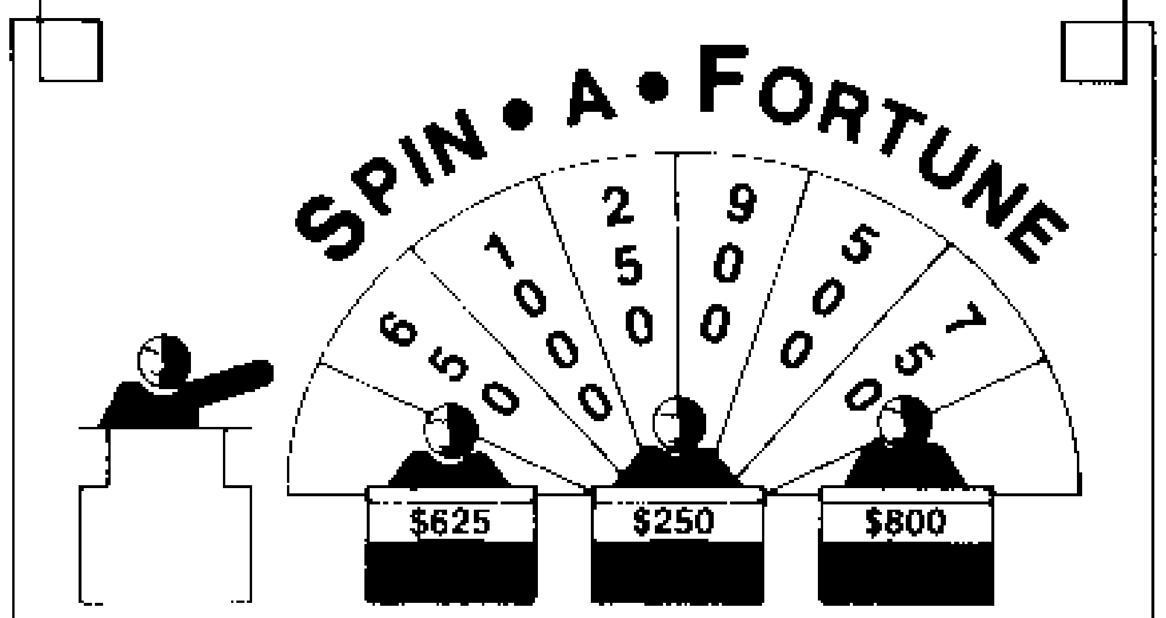
PAGES LEFT:  273
```

Figure 6

```
FILE:     REFUNDS
DATE:     4/1/83
TITLE:    SAMPLE PRINTOUT

INDEX
0 = PAGE #
1 = BRAND
2 = PRODUCT
3 = CATEGORY
4 = VALUE
5 = EXP. DATE
6 = POP TYPE
7 = POP QTY.

0    1            2          3     4      5           6          7
-----------------------------------------------------------------------
1    BRIM         COFFEE     8     5.00   6/30/83     LID        7
2    CADBURY      CHOC BAR   3     1.00   10/31/82    LABEL      5
3    COLGATE      T.PASTE    11B   1.00   9/30/83     UPC        3
4    CRAVE        ANY        12B   .75                UPC        1
5    DR.PEPPER    POP        8     .75    9/30/83     CAP        6
6    JOLLYTIME    POPCORN    3     .50    7/30/83     NET.WT.    10
7    PAM          SPRAY      2     1.00               UPC        5
```



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The DOW EDITOR/ASSEMBLER was designed for those who want to learn assembly language using TI's Mini Memory Module. Without this assembler and its full editing capabilities, you will have to modify already assembled code to get a program to work. But with this assembler, you can work on the program just as you entered it, complete with symbolic instructions, labels, and remarks. You can even run the program, change it and run it again, just as you do with Basic.

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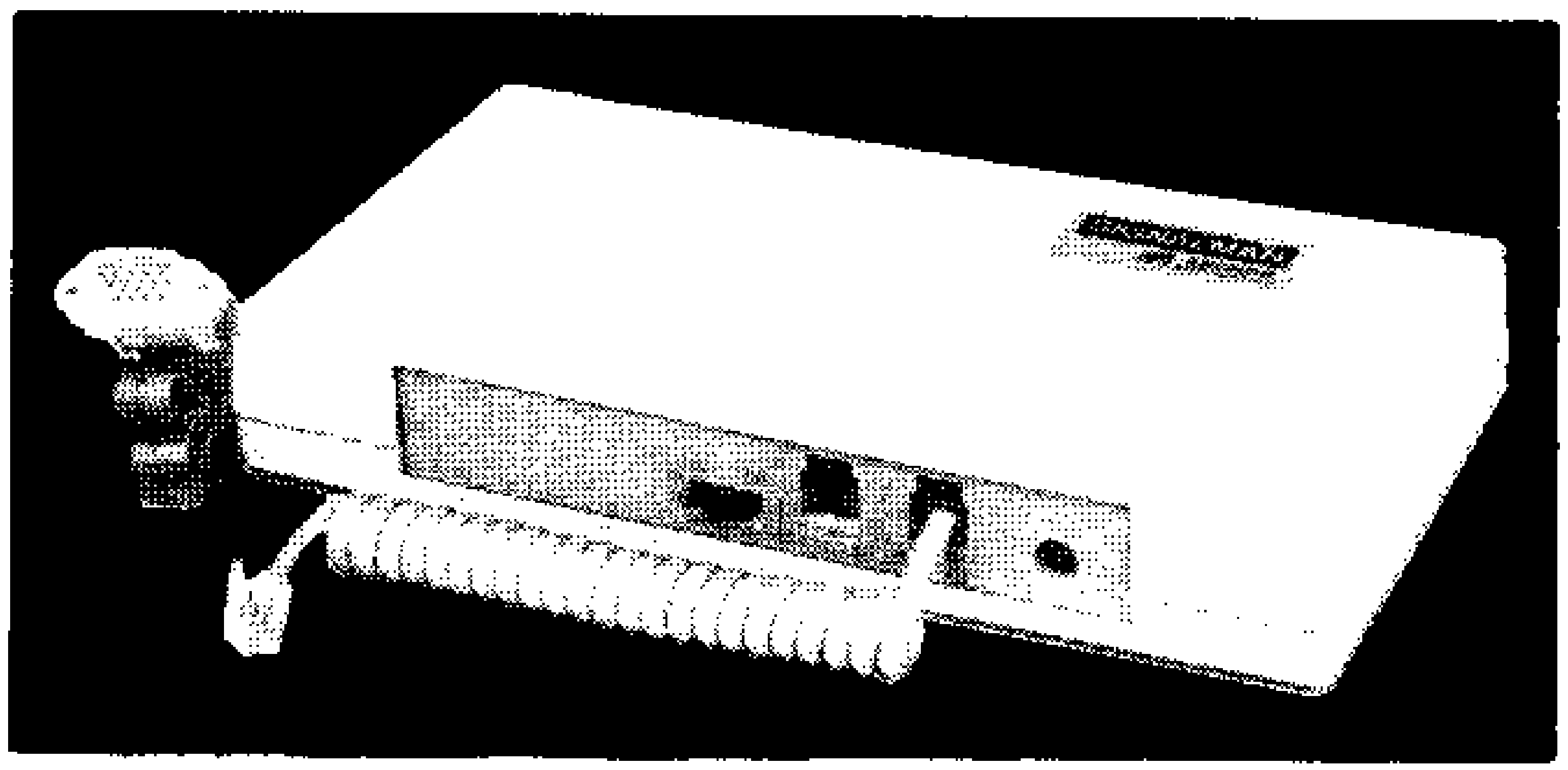

SPECIFICATIONS

		ORIG	ANSW
Data Format	Serial, binary, asynchronous		
Operate Mode	Manual dial, Automatic ANSW/ORIG selection		
Data Rate	0 to 300 bps, full duplex		
Modulation	Frequency shift-keyed (FSK)		
Line Interface	Direct-connect		
Data Interface	TI RS 232C compatible, built-in cable to computer		
Transmit Frequency	MARK	1270 Hz	2225 Hz
	SPACE	1070 Hz	2025 Hz
Transmit Frequency Accuracy	±0.01%		
Transmit Level	–12 dBm typical		
Receive Frequency	MARK	2225 Hz	1270 Hz
	SPACE	2025 Hz	1070 Hz
Receive Frequency Tolerance	±0.5%		
Carrier Detect Threshold	–44 dBm typical		
Carrier Detect Indicator	Audible tone		
Power Requirement	internal 9V transistor battery* or 110 VAC through adapter*		
Size	8¼" x 4⅜" x 1⅜"		

*Not included

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We've been shipping our 32K Memory Card in volume, and customers across the country have been calling to praise our product. As with TI's 32K card, the Foundation Memory Card comes in its own metal case and it plugs into your Peripheral Expansion Box. It runs the same programs as the TI card, including Logo, Pascal, Extended Basic, and Assembler.

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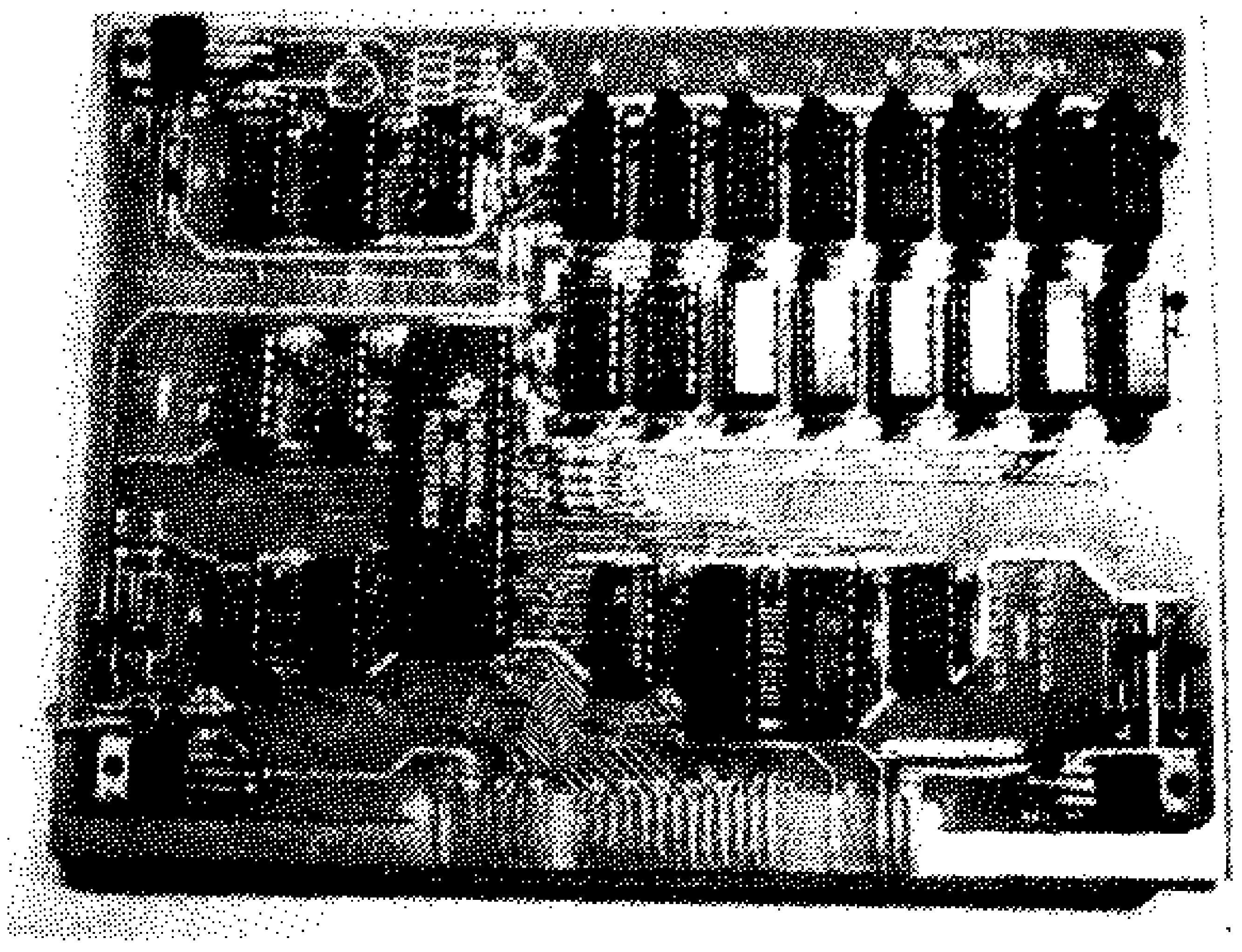

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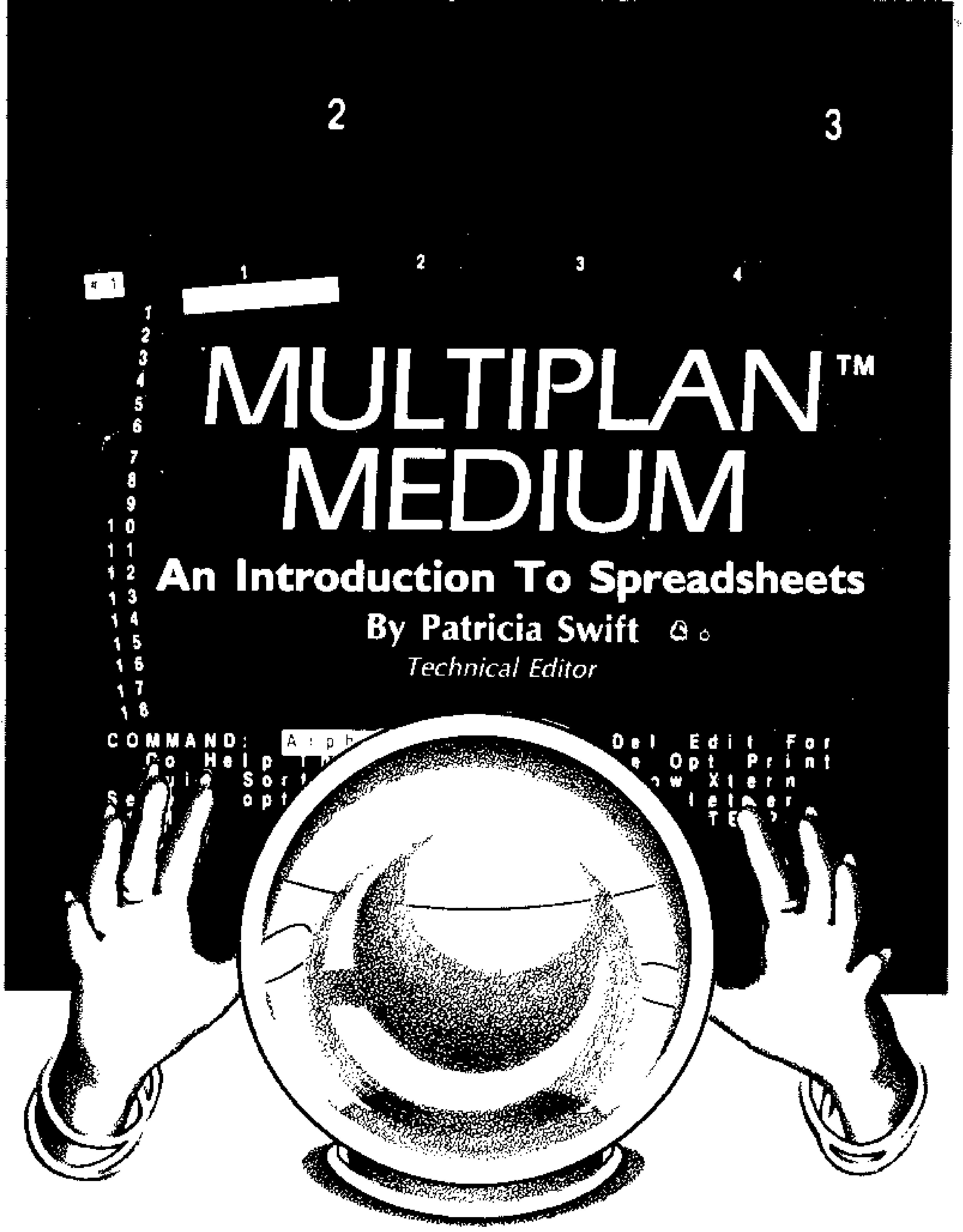


MULTIPLAN™ MEDIUM

An Introduction To Spreadsheets

By Patricia Swift
Technical Editor

Wouldn't it be great if you could create a realistic budget for your household and then measure your progress from time to time? What if you could even predict the effects of changing inflation rates on your budget? How about an easy way to compare the costs of different colleges, or European tours? And if you run your own business, think of how wonderful it would be if you could see where to spend your inventory dollars for the most profitable results, or vary your proposed expenditure and see the projected return . . .

What if you could do all these things and more on your Home Computer using a single software package? Well, now you can—with the *Multiplan*™ package, a sophisticated *spreadsheet* program available for the TI-99/4A.

Spreadsheet History

Accountants and others who perform financial analysis have been using spreadsheets for a long time. A spreadsheet is simply a rectangular worksheet containing rows and columns of numbers. The most basic example of a spreadsheet is a column of numbers with a total. If any of the numbers change, then the total must also be changed. The more complicated the spreadsheet, the more work must be done every time a number changes. Until a few years ago, most spreadsheets were laboriously produced by hand. Imagine the hours of work involved in preparing a financial forecast and then updating it to reflect changing conditions!

The advent of microcomputers for business changed all that. One of the first programs for small business computers was an automatic spreadsheet package called *Visi-Calc*™ (a product of VisiCorp). Although this program remains enormously popular, many other spreadsheet programs are now available for business computers, from micros to mainframes. They all benefit their users in making it easier to set up a spreadsheet, change it, and store it magnetically for later use.

Microsoft's *Multiplan* is a "second-generation" spreadsheet package which offers several advantages over *Visi-Calc* and other "first-generation" spreadsheet software. For one thing, *Multiplan* is easier to learn and use than *Visi-Calc*. It also offers more flexibility in the way the spreadsheet appears both on the screen and as a print-out. It allows you to *sort* the information on the spreadsheet, and even lets you *link* worksheets together so that information can be shared among them.

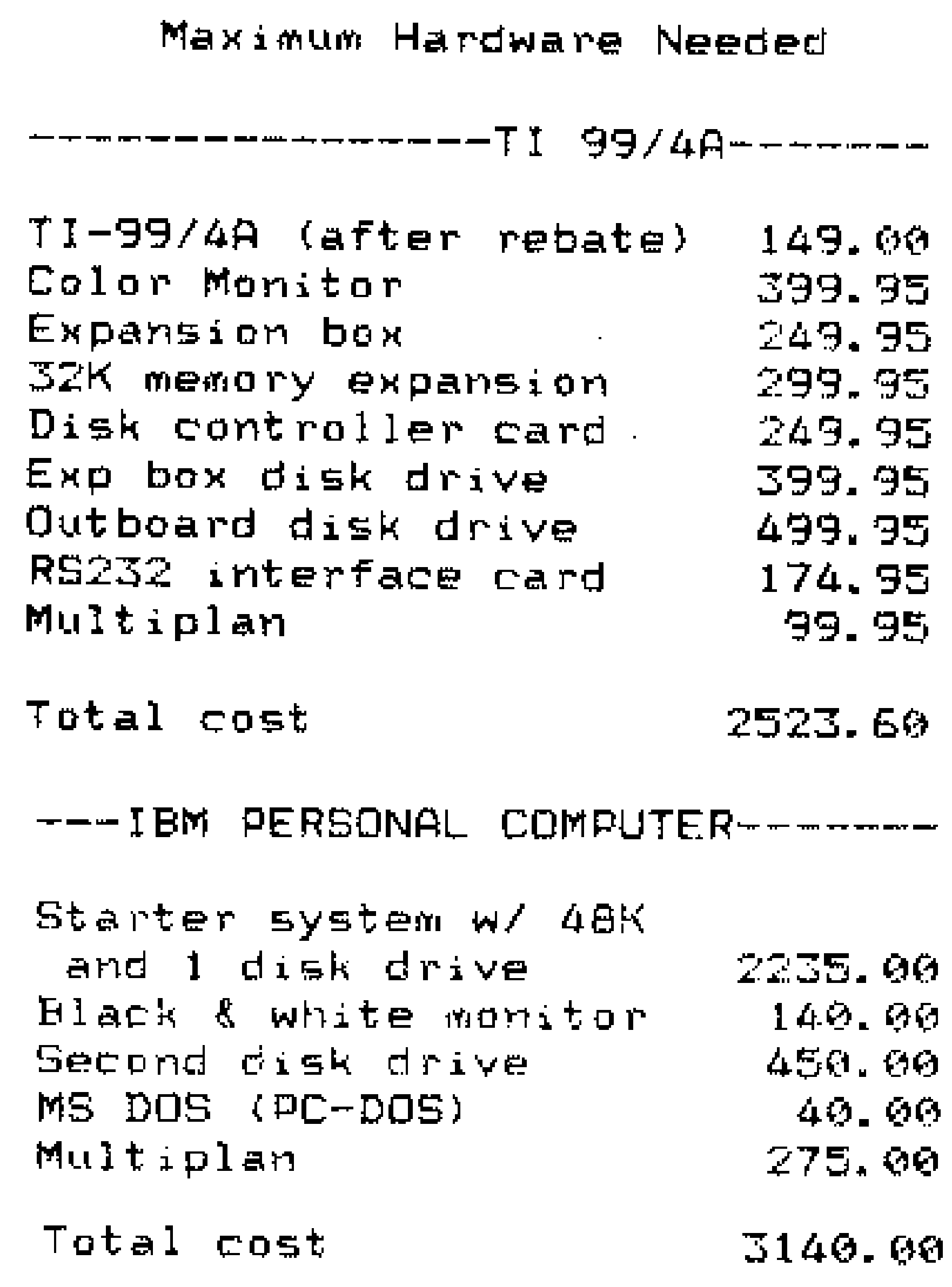
In the course of my work, I recently had to choose a spreadsheet package to do financial planning on a small business computer. After researching the available software—comparing ease of use, quality of reports, and computation ability—I chose *Multiplan*. It proved to be a good choice. I was, therefore, delighted to learn that Microsoft and TI have made a version of the same excelle package for the TI-99/4

Business Applicatio Move Into the Home

The distinction betwee business and home micro computing is becomin more blurred all the tim *Multiplan* is a prime example of a *crossover* progra The homeowner and th business person both u budgets. The busines budget probably has mor items and may use larg numbers, but the sam types of layout and calcu ations are used for bot types of budget. *Multipla* would be very useful both environments.

The minimum micro computer for busines would have 48K of ma memory, two disk drive and almost always a prin er. This is a bit mor equipment than you wou see in the typical hom computer configuratio Because it is a sophisticate program, *Multiplan* nee 48K of memory. Although two disk drives would be more co venient, you can get by quite nicely with one drive—assumin that you are not trying to process a large number of spreadshee quickly. As for a printer, *Multiplan* does not require on Whether you need a printer to make use of the information th program provides is another question. If you use *Multiplan* o ly to arrive at a general strategy or a single answer, then yo might not need a printer; in most other applications, you probably would.

Figure 1



```
              Maximum Hardware Needed

    ---------------TI 99/4A-------

    TI-99/4A (after rebate)  149.00
    Color Monitor            399.95
    Expansion box            249.95
    32K memory expansion     299.95
    Disk controller card     249.95
    Exp box disk drive       399.95
    Outboard disk drive      499.95
    RS232 interface card     174.95
    Multiplan                 99.95

    Total cost              2523.60

    ---IBM PERSONAL COMPUTER-------

    Starter system w/ 48K
     and 1 disk drive       2235.00
    Black & white monitor    140.00
    Second disk drive        450.00
    MS DOS (PC-DOS)           40.00
    Multiplan                275.00

    Total cost              3140.00
```

TI equipment is often sold substantially discounted while IBM is not. Therefore, a true cost comparison would show an even greater difference.

Le Grand Prix

One big difference between software for the home and programs designed for business is the price. That is one of the most exciting things about *Multiplan* on the TI Home Computer. Let's compare the prices for the TI Home Computer system and the IBM Personal Computer system both running *Multiplan*. To make the comparison as fair as possible, I will first compare systems with all of the following features: 48K main memory, two floppy disk drives, and a printer interface (but not printers, since that would be the same for both).

Figure 1 shows this price comparison, based on manufacturers' suggested retail prices. There are significant differences between the systems: TI's disk drives hold only 90K each, while the IBM system has about 160K per disk. Screen sizes differ, too: The 99/4A shows 40 × 24 characters while the IBM shows 25 × 80. You can see that the TI Home Computer with *Multiplan* is the least expensive way to go.

Figure 2

```
            Minimum Hardware Needed


       ----------------TI 99/4A--------

       TI-99/4A (after rebate)  149.00
       Black & White TV          89.00
       Expansion box            249.95
       32K memory expansion     299.95
       Disk controller card     249.95
       Exp box disk drive       399.95
       Multiplan                 99.95

       Total cost              1537.75

        ---IBM PERSONAL COMPUTER-------

        Starter system w/ 48K
         and 1 disk drive      2235.00
        Black & white monitor   140.00
        MS DOS (PC-DOS)          40.00
        Multiplan               275.00



        Total cost             2690.00
```

Figure 2 compares the same systems, but this time in the minimum configuration necessary for running *Multiplan*. In this instance the TI-99/4A really shines. Again, the TI's disk drive holds 90K as opposed to 160K for the IBM. But for the home user, 90K should be sufficient disk storage. To give you an idea of disk file sizes, Figure 1 occupies less than 2K of disk. In fact, none of the *Multiplan* sample spreadsheets presented in this article took more than 4K of disk storage.

Some Sample Spreadsheets

Figures 3 through 9 show a few of the things you can do with *Multiplan* on the TI-99/4A.

Figure 3

```
Income Tax Projection

Income:
 Wages, salaries, tips   10325.00
 Interest                  150.00
 Tax refunds                50.00
 Business income (sch C)  1200.00
Total Income             11725.00

Adjustments to income:
 Moving expense            543.50
 Payments to IRA          1200.00
 Married deduction         500.00
Total adjustments         2243.50

Gross adjusted income     9481.50

Tax computation:
 Itemized deductions      1506.66
 Exemption allowance      2000.00
 Taxable income           5974.84
 Tax rate                   22.00%
Income tax                1314.46

Less taxes withheld       1600.00

Income tax to pay         -285.54
```

Figure 3 is a simple income tax projection. It is loosely based on Form 1040, and shows only those lines which apply to the taxpayer who was using *Multiplan*. Income and adjustments are totalled, and the second is subtracted from the first to arrive at the gross adjusted income. Deductions and exemptions are then subtracted from that figure to compute taxable income, and the tax rate is applied to taxable income to calculate the amount of tax. Finally, the taxes already withheld are subtracted, giving the amount of tax still owed (or refund due, in this case).

This income tax worksheet (or "model," as we will call it) can be useful as an arithmetic checker when you are preparing your 1040. But it is even more useful in *projecting* your income tax liability before the end of the tax year. Then you can play with the model to see what the tax liability will be under different circumstances. For example, you might want to put more money into your IRA account before your year closes. If you do that, it will reduce your gross adjusted income and possibly put you into a lower tax bracket. This, in turn, might mean that you should claim more exemptions so that your employer will not withhold as much from your salary. Once your model is made up, it is a simple matter to adjust the IRA amount and the tax rate; *Multiplan* does the rest . . .

Figure 4 shows that ever-popular application, balancing the checkbook. Each family would probably have different expenses to keep track of, but the principles are the same. When it is time to reconcile your checkbook with your bank statement, *Multiplan* really helps. If you enter a check amount incorrectly, all you have to do is change that one figure; you'll see the effect of that change on your Balance and Totals almost immediately. If you've left out a check or need to add a service charge, it is easily done. And you can reuse the model or a copy of it for next month's checks.

Continued on p. 38

Figure 4

```
Checkbook Balancer  January

Check#  Paid to      Income     Rent       Food       Clothing  Educat'n  Recreat'n Other     Balance

        Forward                                                                              1039.70
   1029 Home Rlty               250.00                                                        789.70
   1030 Shop-Rite                          52.10                                              737.60
        Paycheck      1023.00                                                                1760.60
   1031 U of O                                                   745.00                      1015.60
   1032 Tino's                                                             10.55             1005.05
   1033 B Dalton                                                 153.50                       851.55
   1034 Shop-Rite                          36.68                                              814.87
   1035 VISA                                          202.50               35.60              576.77
   1036 Shop-Rite                          42.40                                              534.37
   1037 Emporium                                       90.00                                  444.37
   1038 Cash                                                                         50.00    394.37

        Totals        1023.00   250.00    131.18     292.50     898.50     46.15     50.00
```

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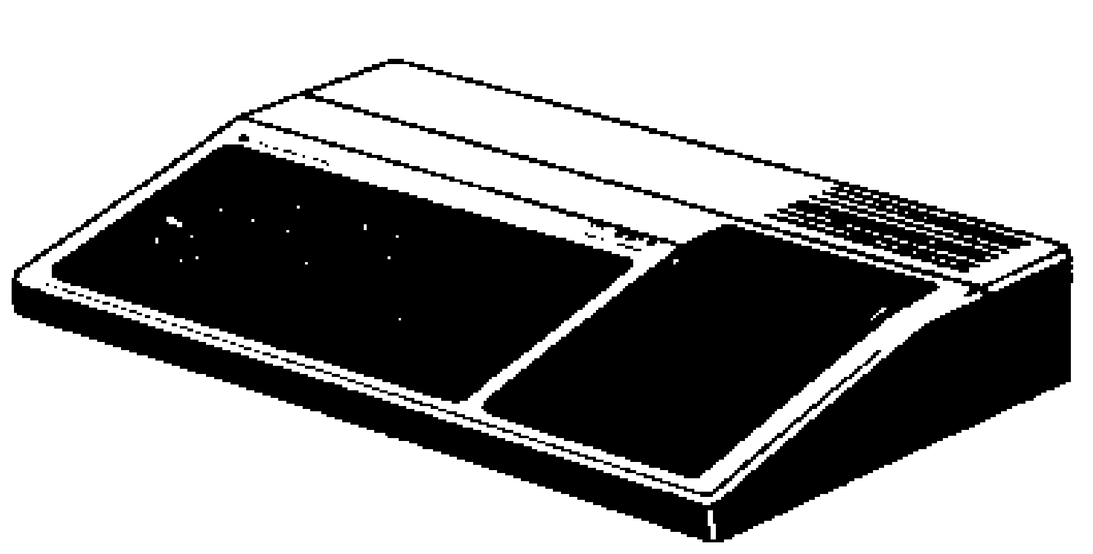

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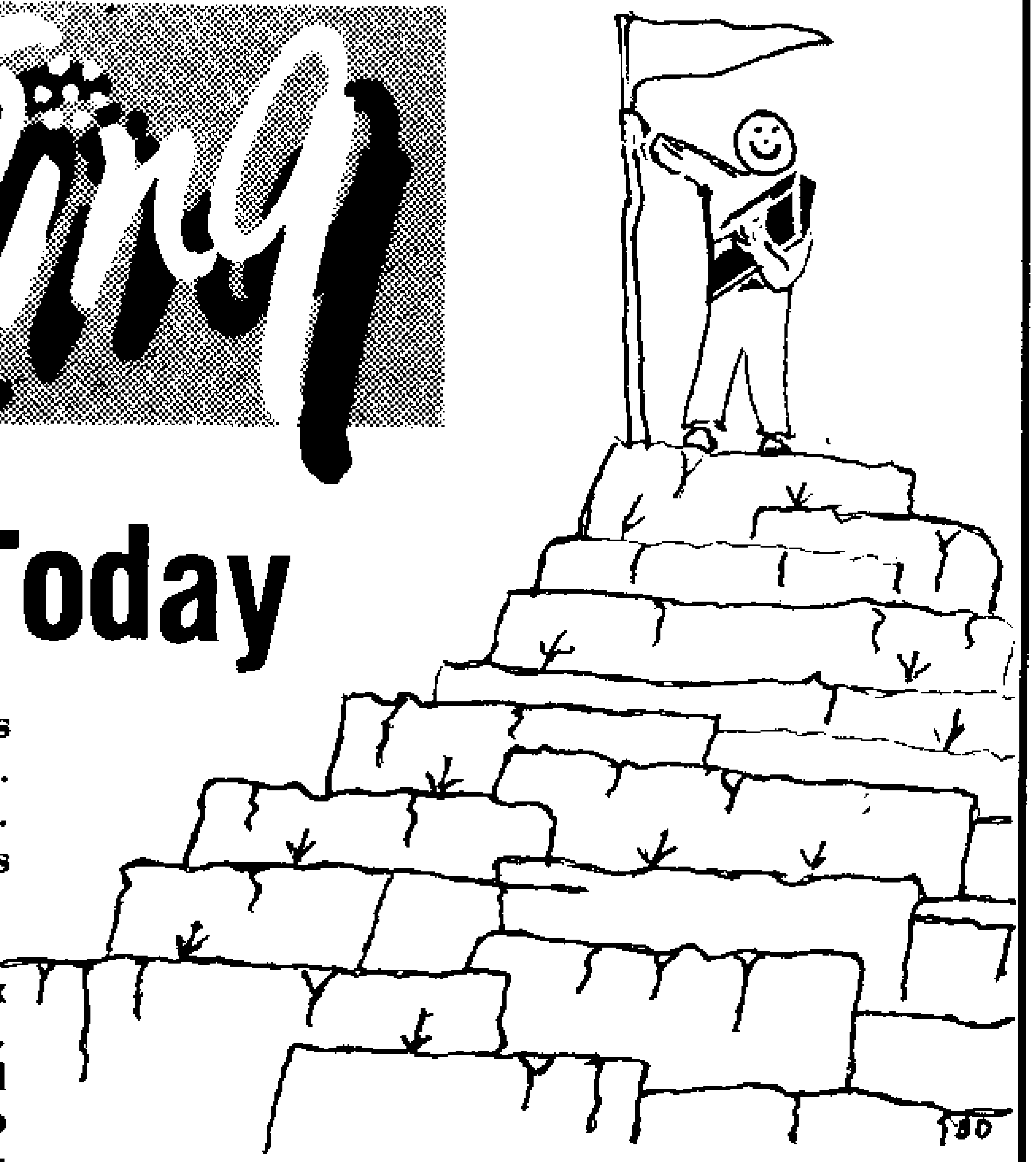

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Adventure International Packages (Developed by Scott Adams)			
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PHM 3041T	Adventure (Pirate Adventure Cassette Game Included)	49.95	**40.00**
Gabriel Industries Packages (Developed by Gabriel Industries)			
PHM 3067	Othello(3) (Developed by Gabriel Industries)	39.95	**32.00**
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Texas Instruments Packages			
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PHD 5057	Tombstone City: 21st Century (32K Memory Expansion and Extended BASIC Command Module are required)	19.95	**16.00**
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PHD 5054	Savage Island I & II	39.95	**32.00**
PHD 5056	Golden Voyage	29.95	**24.00**
	Cassette		
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PHT 6015	Oldies But Goodies—Games I	14.95	**12.00**
PHT 6017	Oldies But Goodies—Games II	19.95	**16.00**
PHT 6025	Saturday Night Bingo (Solid State Speech™ Synthesizer is required)	24.95	**20.00**
PHT 6037	Draw Poker	19.95	**16.00**
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PHT 6047	Mission Impossible	29.95	**24.00**
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PHM 3011	Speech Editor (Solid State Speech™ Synthesizer is required)	44.95	**36.00**
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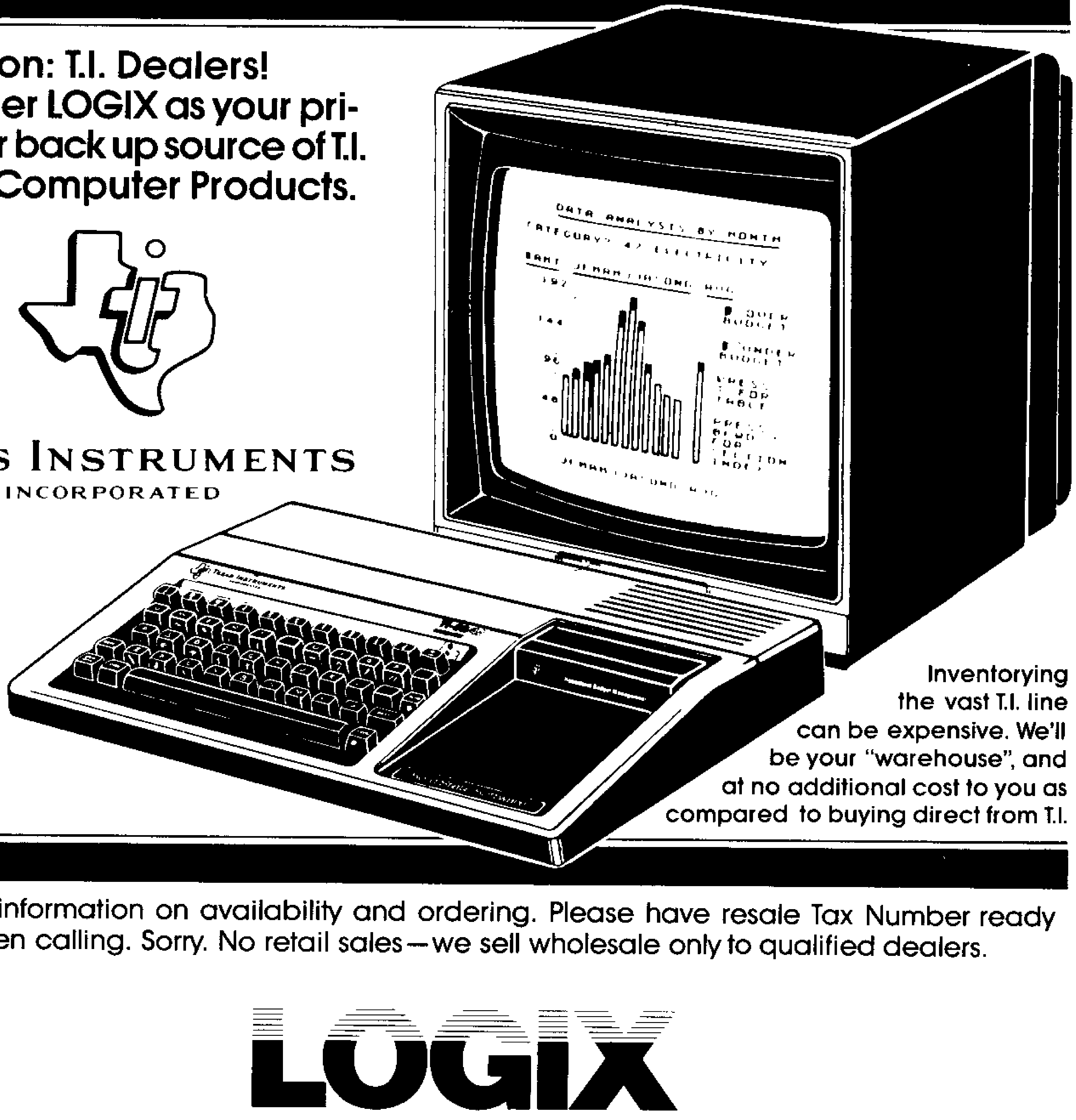

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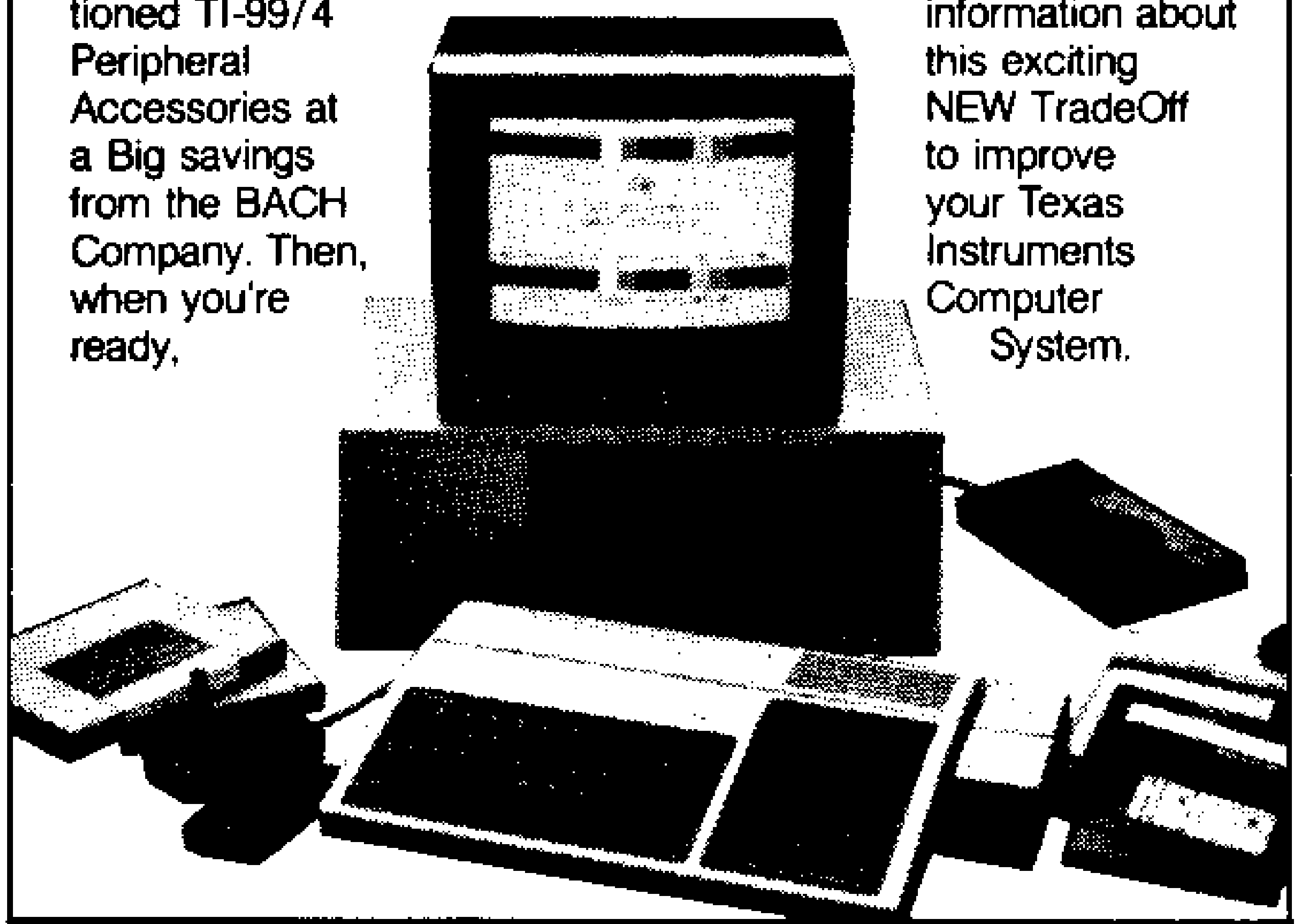

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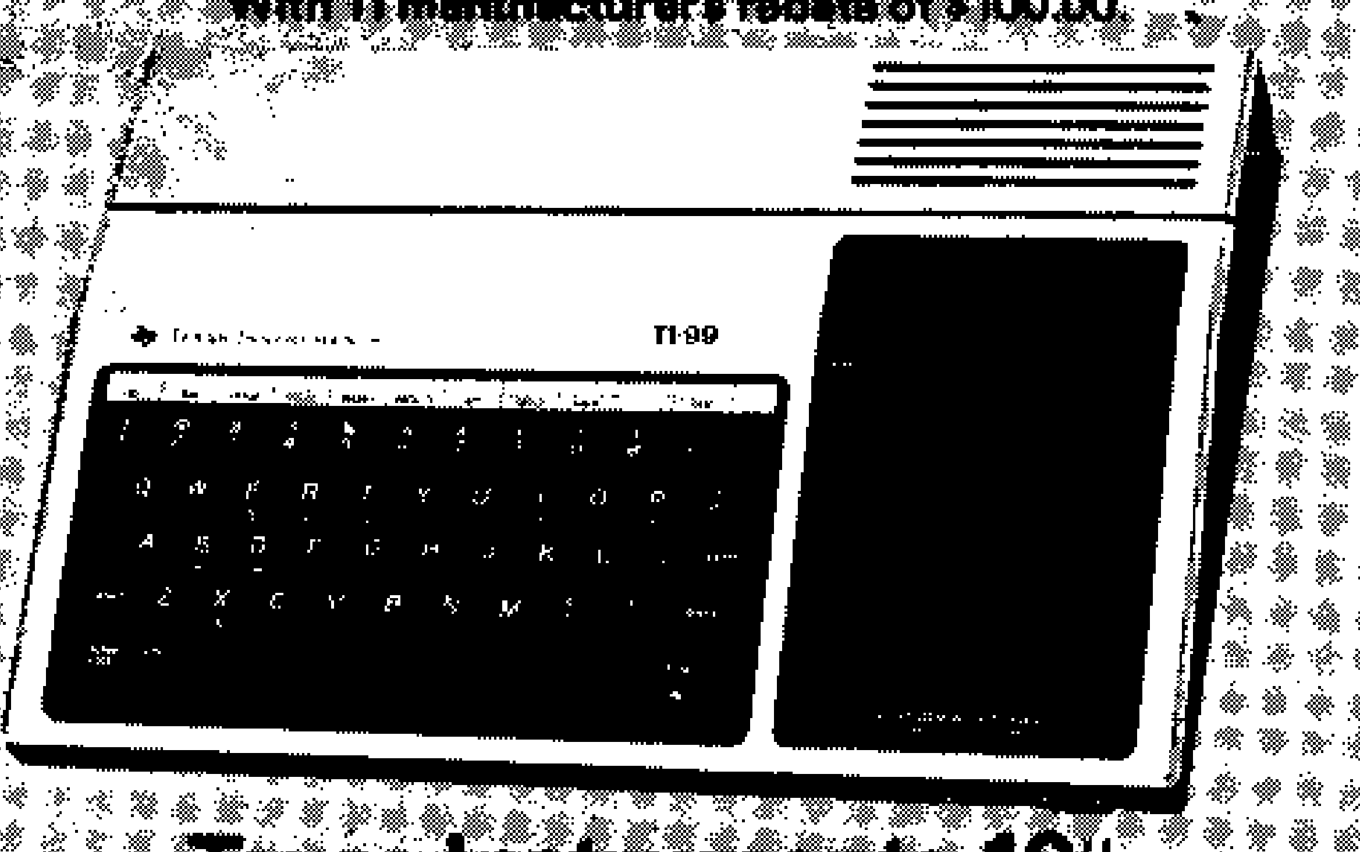

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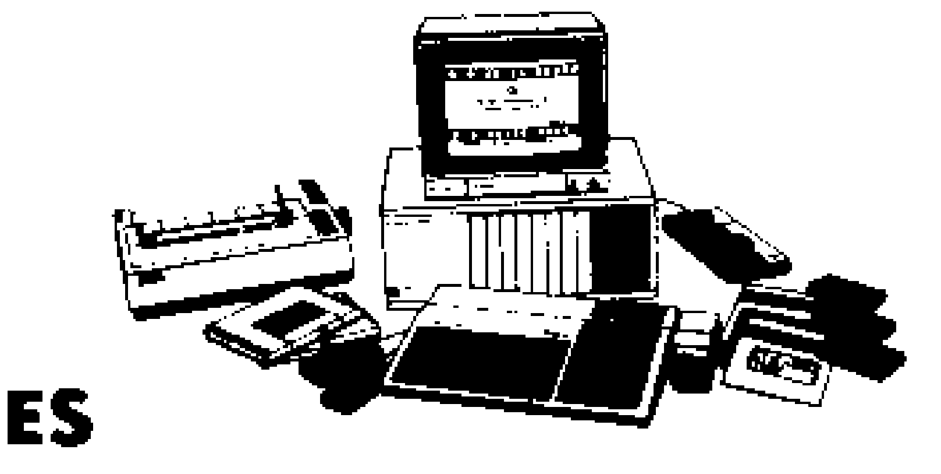

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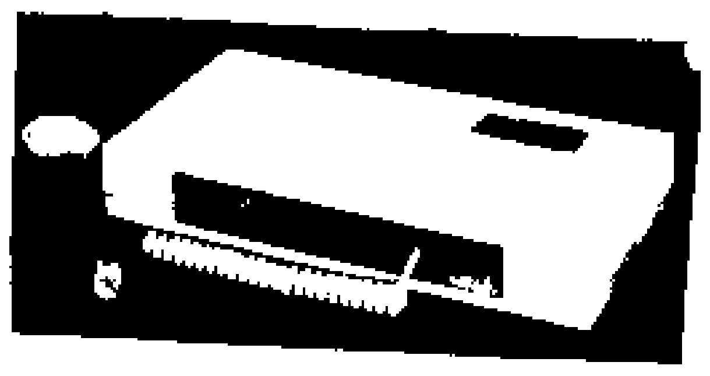

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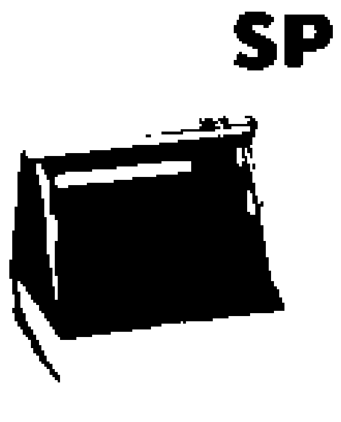

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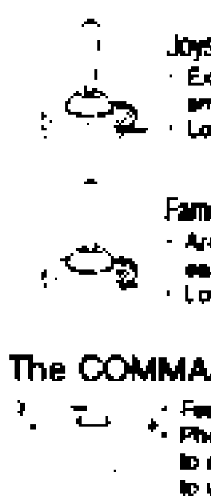

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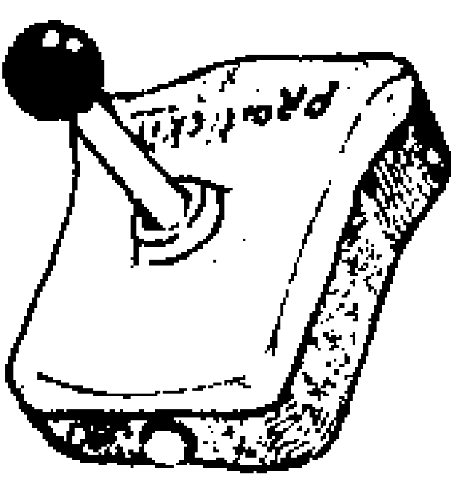

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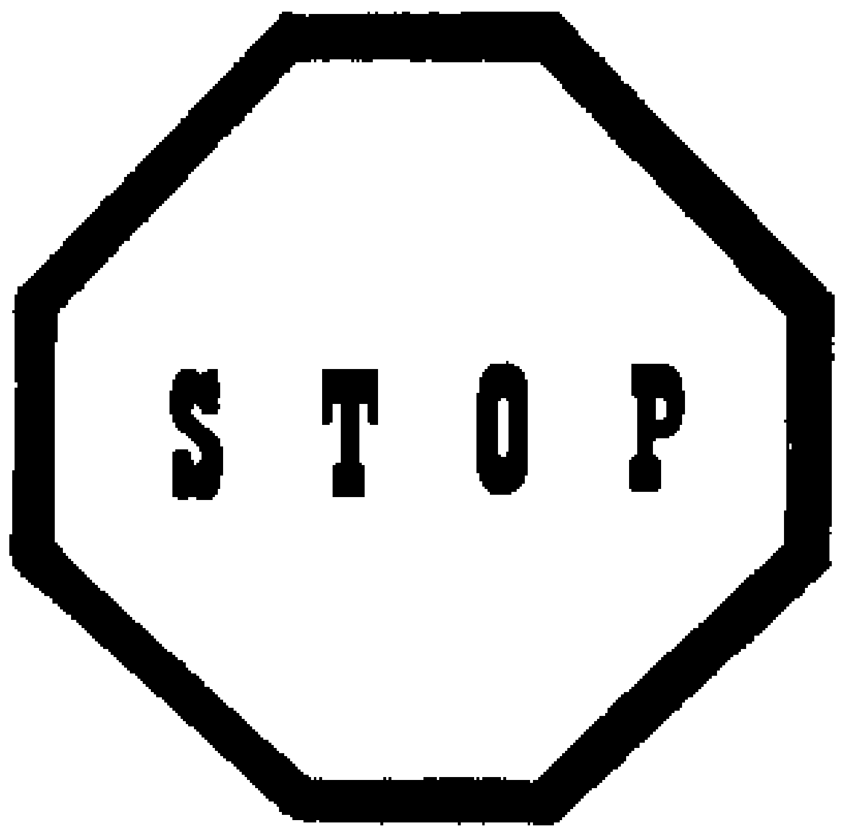

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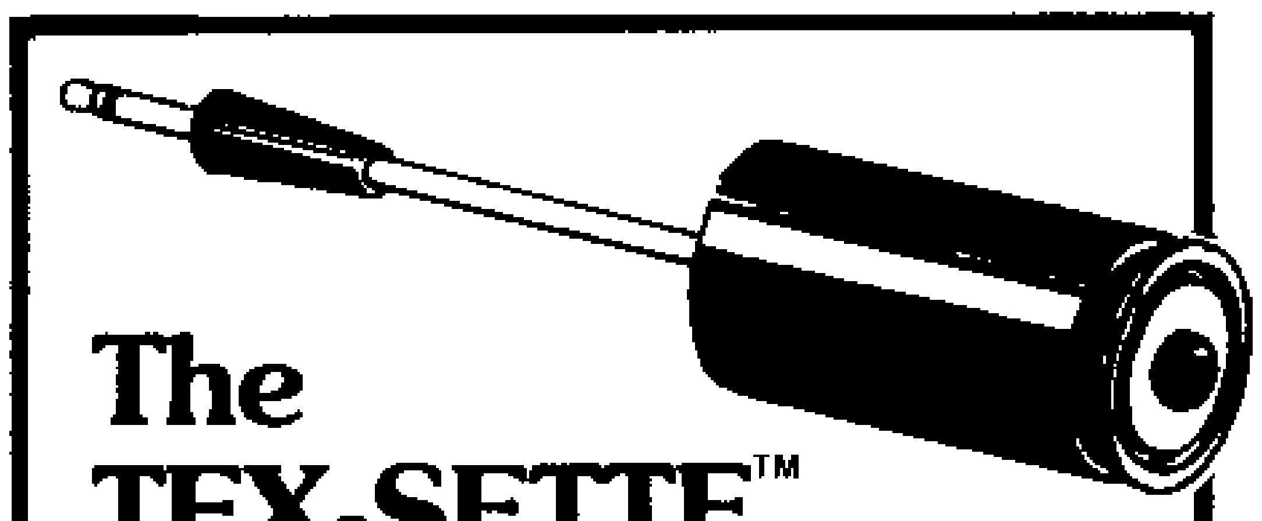

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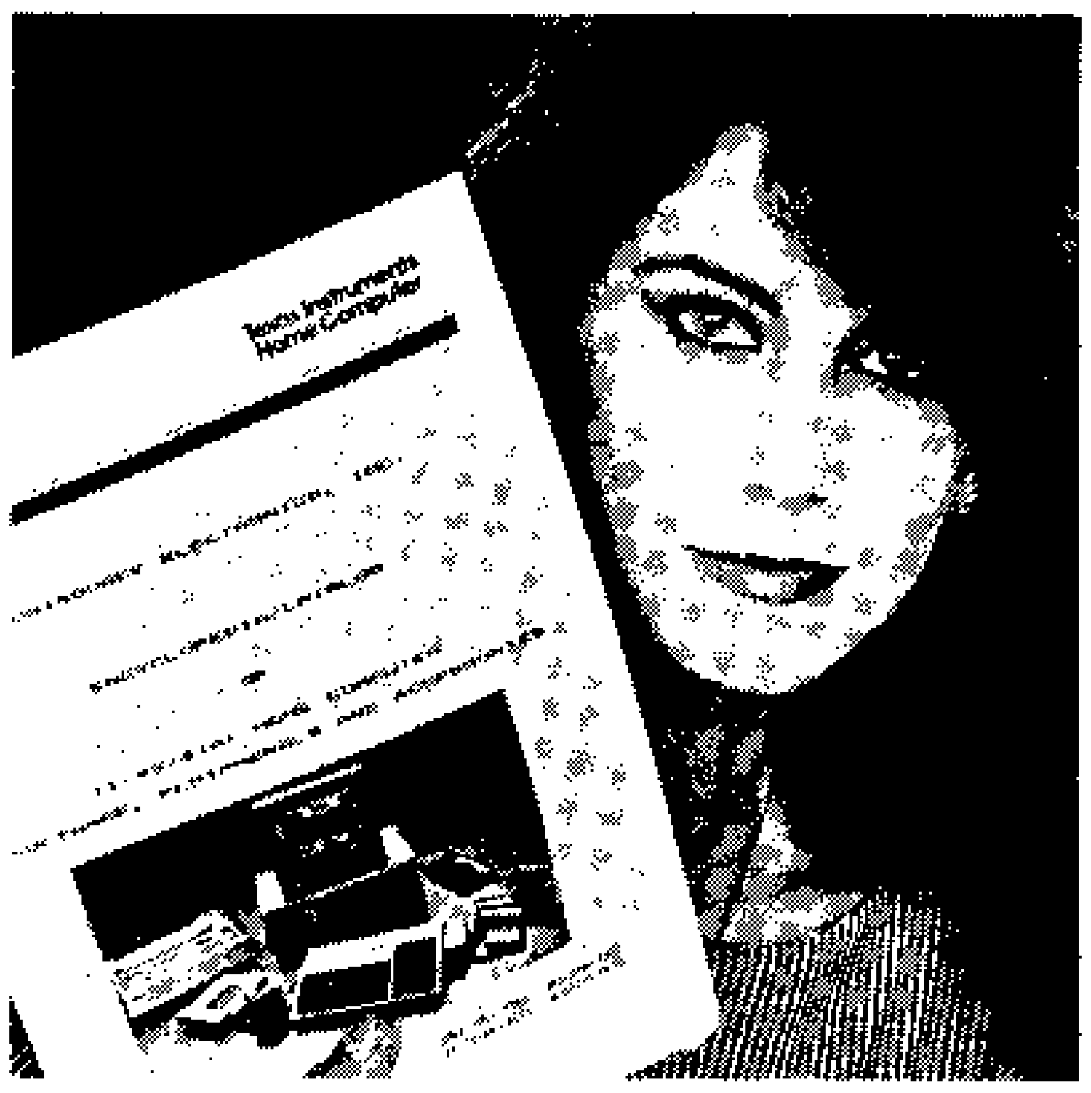

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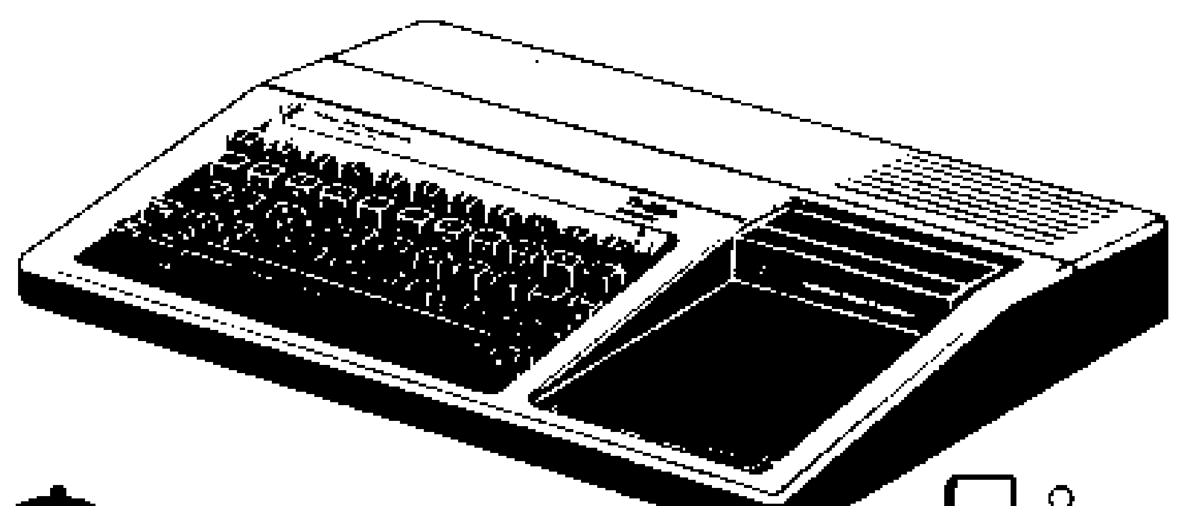

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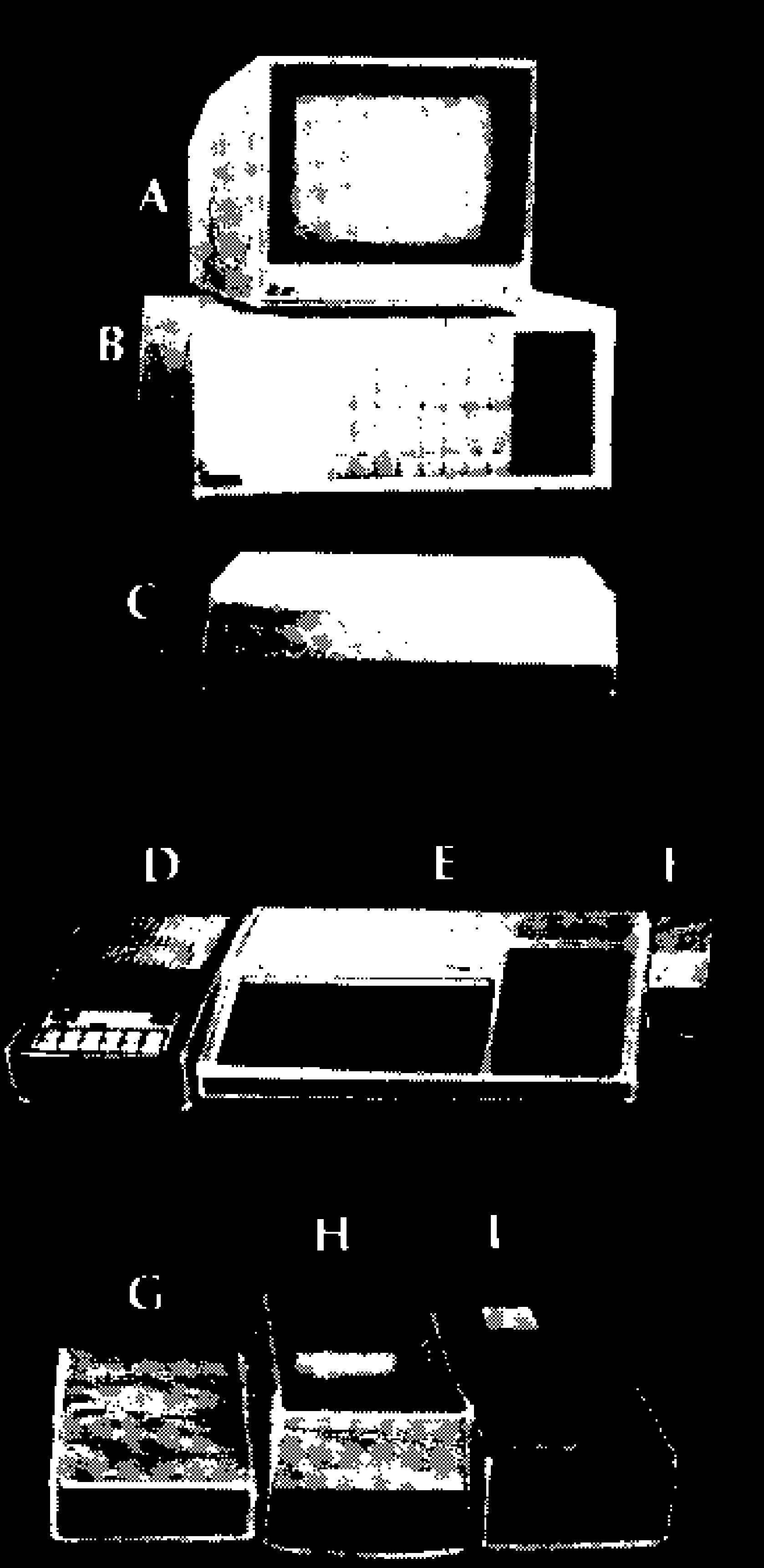

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BOA ALLEY . . . from p. 25

```
710 X1=16
720 Y1=21
730 M1=0
740 N1=-1
750 FL=0
760 L=0
770 SC=0
780 CALL HCHAR(1,2,136,29)
790 A$="SCORE:0"
800 J=10
810 GOSUB 1920
820 FOR I=6 TO 10 STEP 4
830 FOR J=7 TO 25
840 CALL SOUND(1,2000,0)
850 CALL VCHAR(I,J,132)
860 L=L+1
870 P(L,1)=I
880 P(L,2)=J
890 NEXT J
900 CALL SOUND(1,2000,0)
910 CALL VCHAR(I+1,J-1,131)
920 L=L+1
930 P(L,1)=I+1
940 P(L,2)=J-1
950 FOR J=25 TO 7 STEP -1
960 CALL SOUND(1,2000,0)
970 CALL VCHAR(I+2,J,128)
```

```
980 L=L+1
990 P(L,1)=I+2
1000 P(L,2)=J
1010 NEXT J
1020 CALL SOUND(1,2000,0)
1030 CALL VCHAR(I+3,J+1,131)
1040 L=L+1
1050 P(L,1)=I+3
1060 P(L,2)=J+1
1070 NEXT I
1080 FOR J=7 TO 25
1090 CALL SOUND(1,2000,0)
1100 CALL VCHAR(14,J,132)
1110 L=L+1
1120 P(L,1)=14
1130 P(L,2)=J
1140 NEXT J
1150 CALL SOUND(1,2000,0)
1160 CALL VCHAR(15,25,131)
1170 L=L+1
1180 P(L,1)=15
1190 P(L,2)=25
1200 FOR J=25 TO 21 STEP -1
1210 CALL SOUND(1,2000,0)
1220 CALL VCHAR(16,J,128)
1230 L=L+1
1240 P(L,1)=16
1250 P(L,2)=J
1260 NEXT J
```

```
1270 RX=INT(RND*22)+2
1280 RY=INT(RND*27)+3
1290 CALL GCHAR(RX,RY,C)
1300 IF C<>32 THEN 1330
1310 CALL VCHAR(RX,RY,120)
1320 FL=1
1330 IF O1=50 THEN 1510
1340 CALL KEY(1,S,T)
1350 IF S<>5 THEN 1390
1360 M1=-1
1370 N1=0
1380 GOTO 1550
1390 IF S<>3 THEN 1430
1400 M1=0
1410 N1=1
1420 GOTO 1550
1430 IF S+1<>1 THEN 1470
1440 M1=1
1450 N1=0
1460 GOTO 1550
1470 IF S<>2 THEN 1550
1480 M1=0
1490 N1=-1
1500 GOTO 1550
1510 CALL JOYST(1,A,B)
1520 IF ABS(A)+ABS(B)<>4 THEN 1550
1530 M1=-B/4
1540 N1=A/4
1550 CALL GCHAR(M1+X1,N1+Y1,C)
1560 IF C=32 THEN 1770
1570 IF C<>120 THEN 1650
1580 CALL SOUND(-100,110,0,1000,0,5
00,0)
1590 SC=SC+1
1600 A$=STR$(SC)
1610 J=16
1620 GOSUB 1920
1630 FL=0
1640 GOTO 1770
1650 CALL SOUND(-500,-7,0)
1660 CALL SCREEN(12)
1670 CALL SCREEN(2)
1680 CALL KEY(0,S1,S2)
1690 IF S2<1 THEN 1680
1700 FOR I=2 TO 22 STEP 2
1710 CALL HCHAR(I,3,32,27)
1720 NEXT I
1730 FOR I=3 TO 29 STEP 2
1740 CALL VCHAR(2,I,32,21)
1750 NEXT I
1760 GOTO 700
1770 CALL VCHAR(X1,Y1,128+2*(N1+1)+
M1)
1780 X1=X1+M1
1790 Y1=Y1+N1
1800 CALL SOUND(-1,2000,0)
1810 IF M1=0 THEN 1840
1820 CALL VCHAR(X1,Y1,96)
1830 GOTO 1850
1840 CALL VCHAR(X1,Y1,97)
1850 CALL VCHAR(P(Q,1),P(Q,2),32)
1860 P(Q,1)=X1
1870 P(Q,2)=Y1
1880 Q=Q+1
1890 IF Q<>106 THEN 1910
1900 Q=1
1910 IF FL=0 THEN 1270 ELSE 1330
1920 FOR I=1 TO LEN(A$)
1930 CALL VCHAR(1,I+J,ASC(SEG$(A$,I
,1)))
1940 NEXT I
1950 RETURN
```

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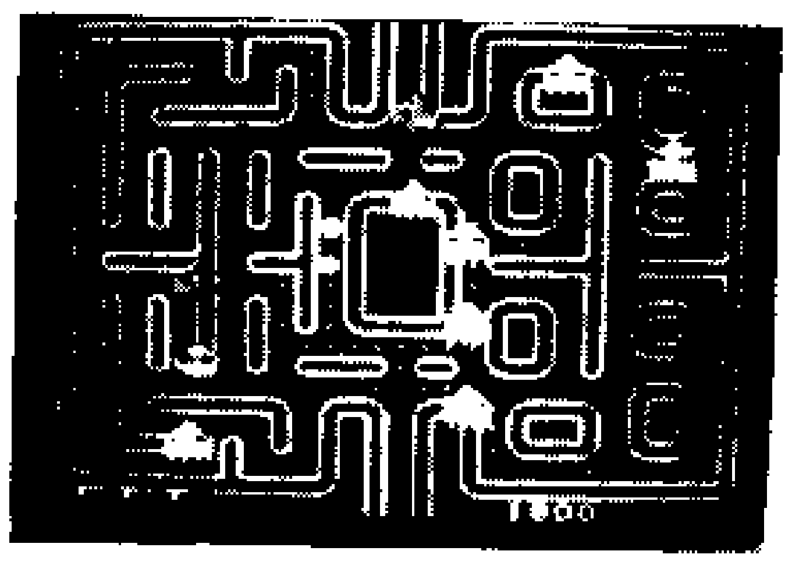

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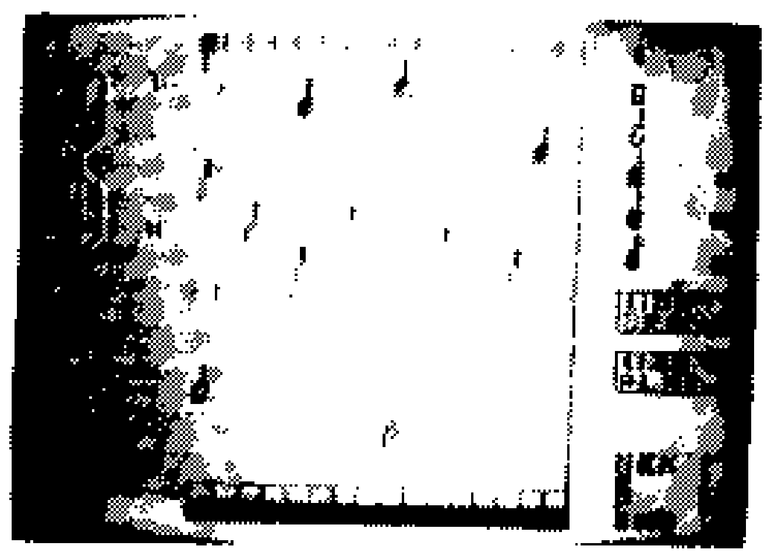

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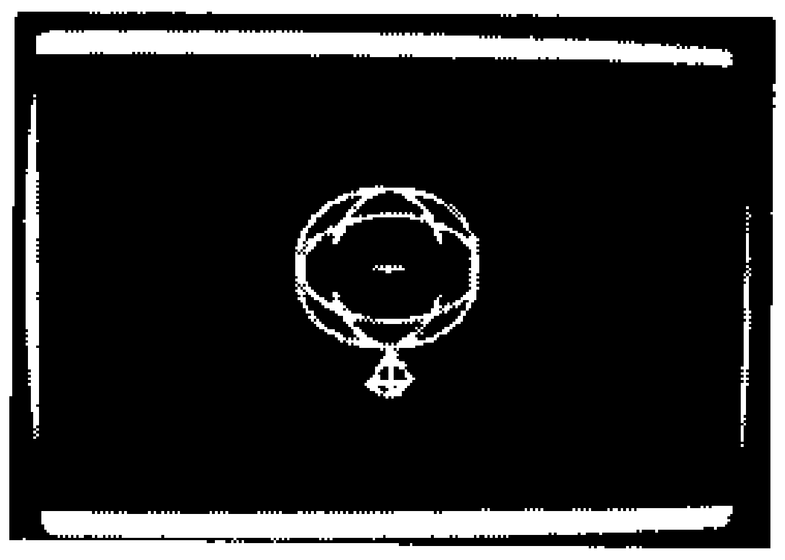

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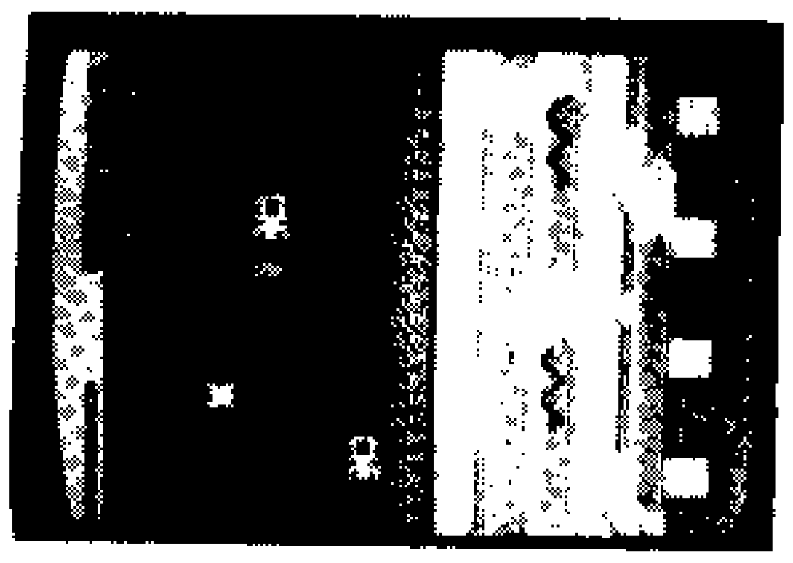

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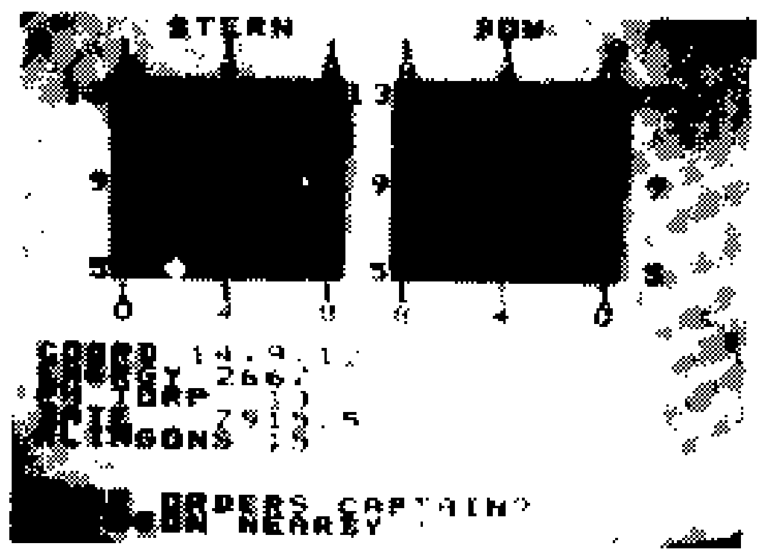

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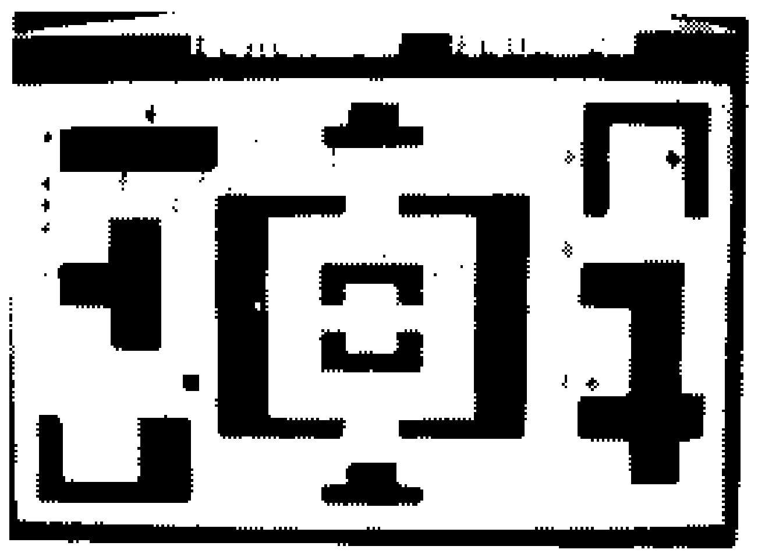

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MULTIPLAN

. . . from p. 35

Figure 5 is a sample home budget. The figures in the "JAN 83 ACTUAL" column were taken from the checkbook totals in the checkbook model in Figure 4. This feature—ability to *link* worksheets—is marvelous. If you fix an error in your checkbook worksheet, the budget worksheet will be changed automatically to reflect the new total for the associated budget item.

In the budget worksheet, you start by entering your actual expenses for 1982. Then the program calculates your 1983 budget based on the inflation rate you set at the top. Since this inflation rate is subject to frequent changes, you can simply change that rate and see how you're doing. Figure 5A show a 6% inflation rate, and Figure 5B shows an 8% rate.

Figure 6 is a projection of home energy usage for the year ahead. In this simple example, we assume that the family has made no lifestyle changes. You enter the kilowatt

Figure 5A

```
Home Budget Projections        Inflation =       6.00%

              1982       1983      JAN 1983   JAN 1983    JAN 1983    LEFT FOR    FEB 1983
             ACTUAL     BUDGET      ACTUAL     BUDGET    DIFFERENCE REST OF 1983   BUDGET

Rent         3000.00    3180.00     250.00     265.00      -15.00     2930.00      266.36
Food         1298.45    1376.36     131.18     114.70       16.48     1245.18      113.20
Clothing     1987.70    2106.96     292.50     175.58      116.92     1814.46      164.95
Educat'n     2550.00    2703.00     898.50     225.25      673.25     1804.50      164.05
Recreat'n     750.00     795.00      46.15      66.25      -20.10      748.85       68.08
Other         900.00     954.00      50.00      79.50      -29.50      904.00       82.18

TOTAL       10486.15   11115.32    1668.33     926.28      742.05     9446.99      858.82
```

Figure 5B

```
Home Budget Projections        Inflation =       8.00%

              1982       1983      JAN 1983   JAN 1983    JAN 1983    LEFT FOR    FEB 1983
             ACTUAL     BUDGET      ACTUAL     BUDGET    DIFFERENCE REST OF 1983   BUDGET

Rent         3000.00    3240.00     250.00     270.00      -20.00     2990.00      271.82
Food         1298.45    1402.33     131.18     116.86       14.32     1271.15      115.56
Clothing     1987.70    2146.72     292.50     178.89      113.61     1854.22      168.57
Educat'n     2550.00    2754.00     898.50     229.50      669.00     1855.50      168.68
Recreat'n     750.00     810.00      46.15      67.50      -21.35      763.85       69.44
Other         900.00     972.00      50.00      81.00      -31.00      922.00       83.82

TOTAL       10486.15   11325.04    1668.33     943.75      724.58     9656.71      877.88
```

Figure 6

```
    Projected Energy    Usage

                --1979--  --1980--  --1981--  ------Projected 1982---------
                KWH used  KWH used  KWH used  KWH used    Rate   Total bill

    January         1198      1200      1276      1225    0.078     95.52
    February        1250      1320      1340      1303    0.078    101.66
    March           1200      1150      1100      1150    0.078     89.70
    April           1092      1260      1003      1118    0.078     87.23
    May             1033       940       900       958    0.078     74.70
    June             570       600       630       600    0.082     49.20
    July             301       202       225       243    0.082     19.90
    August           150       178       156       161    0.082     13.23
    September        680       650       675       668    0.082     54.80
    October         1198      1080      1085      1121    0.082     91.92
    November        1170      1203      1145      1173    0.082     96.16
    December        1300      1302      1260      1287    0.082    105.56

    Totals         11142     11085     10795     11007    0.080    879.59
```

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Figure 7

```
Item          Unit   Unit    Number      Monthly    Cost for 1           -------Recommended------------  Amount left
              Cost   Price   Sold/month  Profit     Month stock  Return  Number    Cost        Profit     To spend

Amt to spend                                                                                               250.00
3 in bolts    1.50   2.99        25       37.25       37.50       99%     25       37.50       37.25       212.50
1 in bolts    0.50   0.75       100       25.00       50.00       50%    100       50.00       25.00       162.50
4 in bolts    5.00   7.50        15       37.50       75.00       50%     15       75.00       37.50        87.50
2 in bolts    0.75   0.99       200       48.00      150.00       32%    117       87.50       28.00         0.00

Totals                                   147.75      312.50                       250.00      127.75
```

Figure 8

```
Cost of travel to San Francisco

                     Air     Train    Bus      Car

Fare                 99.00   75.00    65.00
Meals                        30.00    20.00    20.00
Transportation:
 To terminal          7.50    5.00     5.00
 From terminal       10.00    1.50
Distance                                      350.00
Cost per mile                                   0.20
Driving expense                                70.00
Time spent:
 Hours in transit     3.50   13.00    14.00    11.50
 Value of 1 hour      5.00    5.00     5.00     5.00
Cost of time         17.50   65.00    70.00    57.50

Total cost          134.00  176.50   160.00   147.50
```

hours used over the last three years, along with the anticipated rates for the months of 1983. *Multiplan* projects the usage for each month of 1983 as the average of the same month in the previous years, and computes the utility bill which would result. As new rates are announced, you can easily change them in your model and see the effect on your future bills.

Figure 7 is an inventory analysis for a small business. The assumption here is that the business owners have a certain amount of money to spend on stocking some new items, and they need to decide how to invest those dollars for the maximum return (or profit). They enter the name of each item, its cost, price, and number sold per month. Then *Multiplan* computes the monthly profit, cost of stocking a month's supply of the item, and the percentage of return when the item is sold. Because we are trying to maximize return, the next step is to sort the items by percentage of return. *Multiplan* includes a sort feature which works on alphabetical information as well as numbers. After sorting the items by return, we go on to finish the model. We enter the total amount of money to spend, and then the program decides how many of each item should be bought. The model assumes that the most we want to buy is one month's worth of each item, since turning a profit depends on selling merchandise, not overstocking the shelves.

Figure 8 is a model for determining the true costs of traveling to San Francisco. It illustrates the most important feature of *Multiplan*: It helps you organize your information. This model performs very few calculations, but it provides a way to include all the pertinent facts in the total cost. And if one of the fares goes up or down, it's easy to arrive at new totals.

Figure 9 is a worksheet for calculating the true cost of a year at four different colleges. This is a prime example of a "what if" situation. If the student really wants to attend Trinity, then perhaps she should decide to make fewer trips home during the year and redouble her efforts to qualify for a work/study job.

Multiplan Specifications

As you can tell from these examples, *Multiplan* is quite flexible. The largest worksheet it can handle contains 63 columns by 255 rows. However, this does not mean that you can ac-

Continued on p. 42

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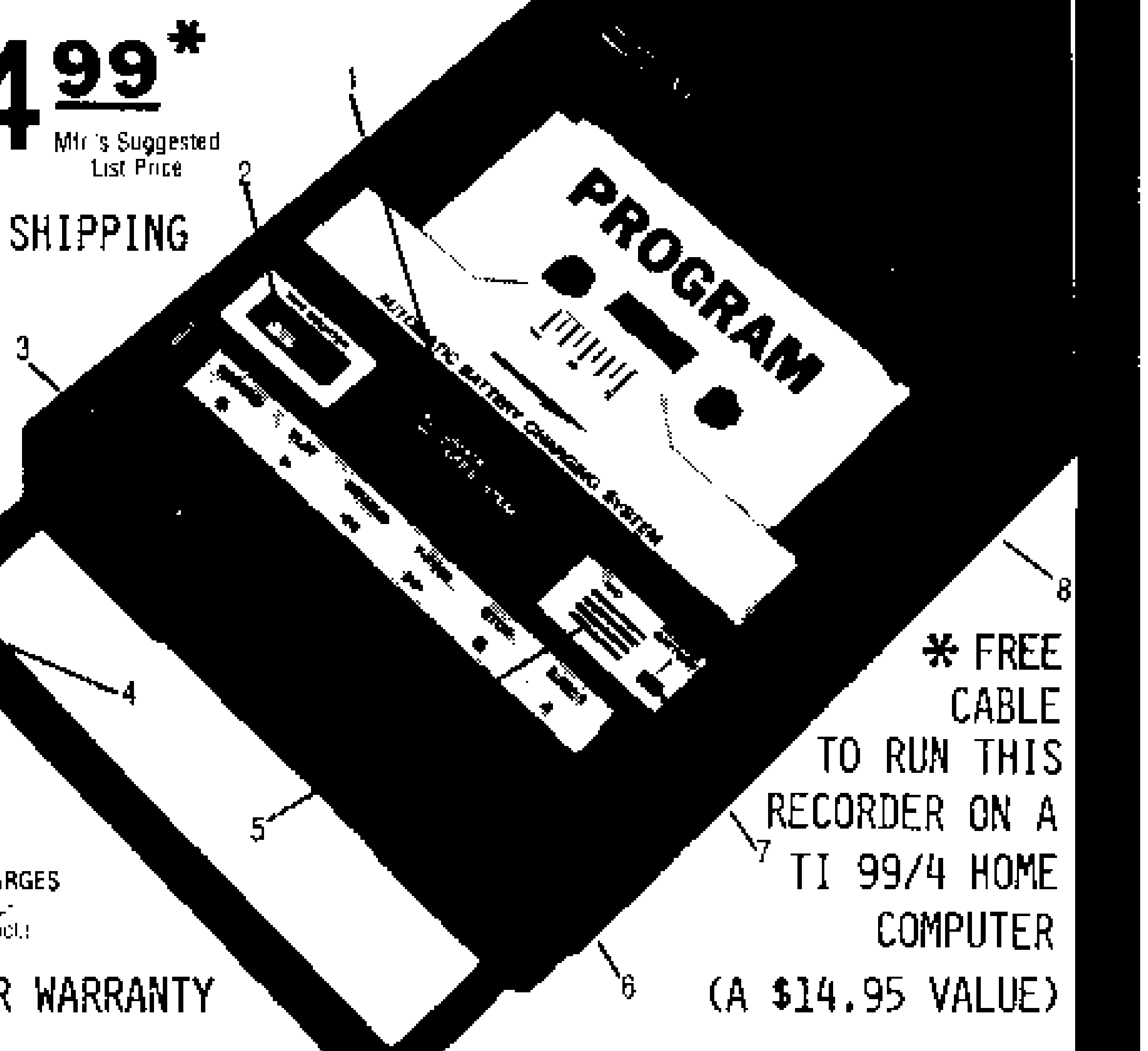

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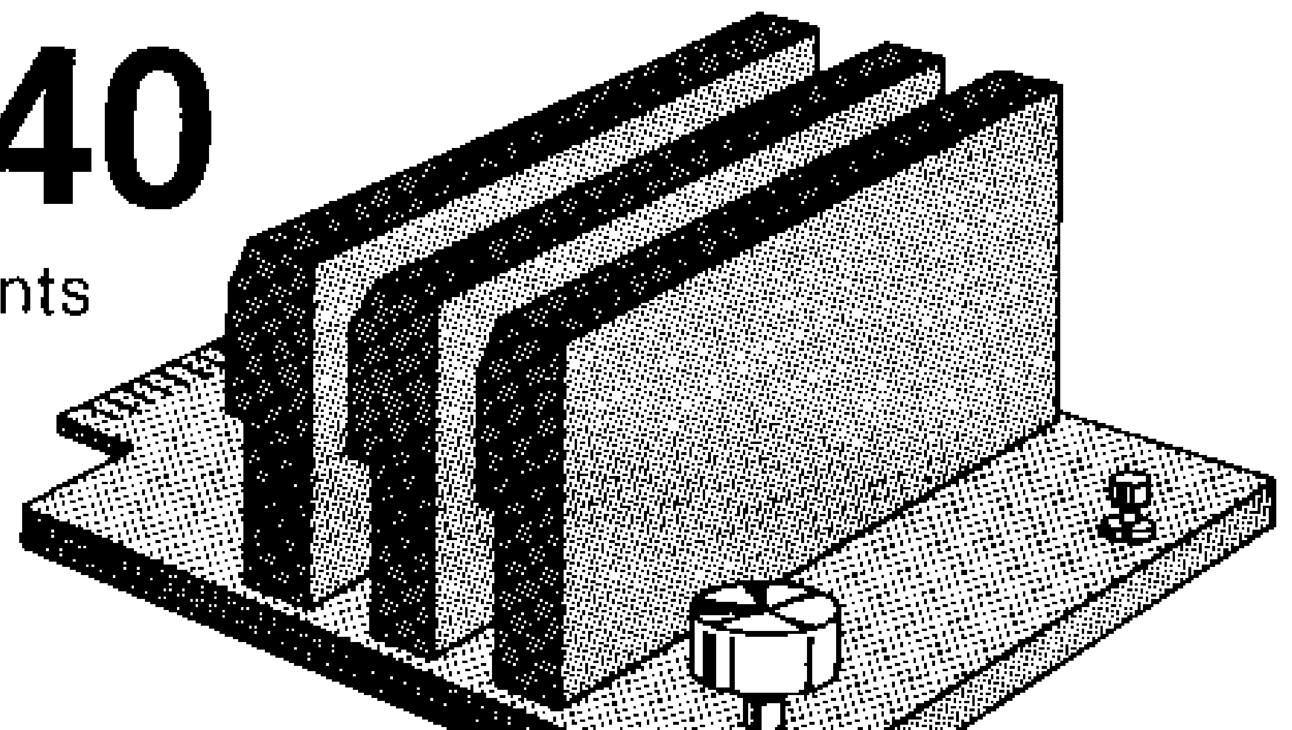

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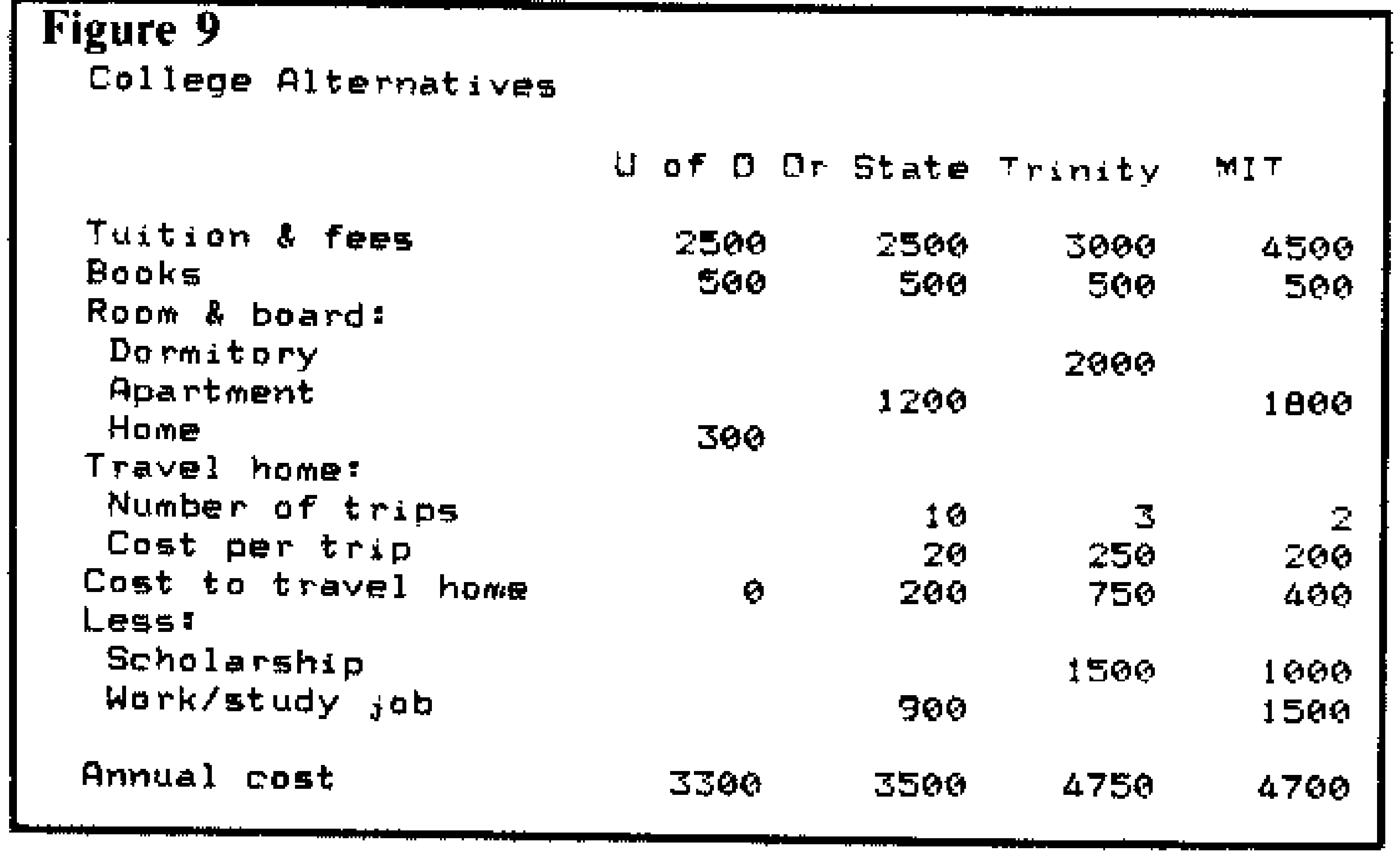
MULTIPLAN . . . from p. 39

Figure 9



```
College Alternatives

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Tuition & fees            2500     2500    3000   4500
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 Dormitory                                 2000
 Apartment                         1200           1800
 Home                      300
Travel home:
 Number of trips                     10       3      2
 Cost per trip                       20     250    200
Cost to travel home          0      200     750    400
Less:
 Scholarship                               1500   1000
 Work/study job                     900           1500

Annual cost               3300     3500    4750   4700
```

tually fill up a worksheet of this size with all types of information. The sample models typically used about 10% of *Multiplan's* capacity. The program constantly displays the percentage of capacity remaining, so there is no danger of suddenly running out of room. And the ability to link worksheets makes it possible to include several models with details connected to a summary worksheet, if you really have a lot of information.

One question instantly jumps to mind: How can the screen of the TI-99/4A show a giant worksheet? The answer is that the screen is a *window* which shows only part of the worksheet at a time. You move this window around to display the portion of the worksheet you need at the moment. And you can *split* the screen into *several* windows.

You also have complete control over the column widths. *Multiplan* starts out with columns 8 characters wide, but you can easily make some of them larger. In the sample models, the first columns are all wider than 8 to accommodate longer descriptions. You also have control over the way the figures are presented: you can use integers (whole numbers), dollar values, percentages, or as many decimal places as you like. You can mix these formats freely, too.

Many models will be too wide to fit on your printer, but that presents no problem. *Multiplan* lets you specify the printer width, and then automatically prints the worksheet *in sections* so that you can paste the print-outs together. You can also print any rectangular portion (that you specify) of the worksheet.

Instead of printing out a worksheet on your printer, you can choose to *print* to a disk file. This means that you can store the output from *Multiplan* on disk for editing later via *TI-Writer*. Think of the possibilities! You can prepare a table using *Multiplan* with all its calculation abilities, and then use the table in a report (or an article) with accompanying text. Of course, the *Multiplan* models themselves can be saved to disk and then recalled later for changes.

The *Multiplan* manual contains a detailed tutorial section to get you started. I found it well written, lavishly illustrated, and very helpful. There is also a reference section to use once you know what you're doing, a handy reference card, and a keyboard overlay strip that shows many of the *function* and *control* keys which can be used.

The tutorial section helps, but what really simplifies the program is the way you enter commands. *Multiplan* has several commands to choose from, all of which are always shown on the screen in English. To select a command, you merely type its first letter. You can also select one by pressing the space bar until the command you want is highlighted, and then hitting the ENTER key. *Multiplan* includes such commands as INSERT (a row or column), DELETE, PRINT, MOVE, WINDOW and HELP. HELP provides information right on the screen about using *Multiplan*. Most of the time, you can get information about the specific command you're using (or trying to use) by typing a question mark (?).

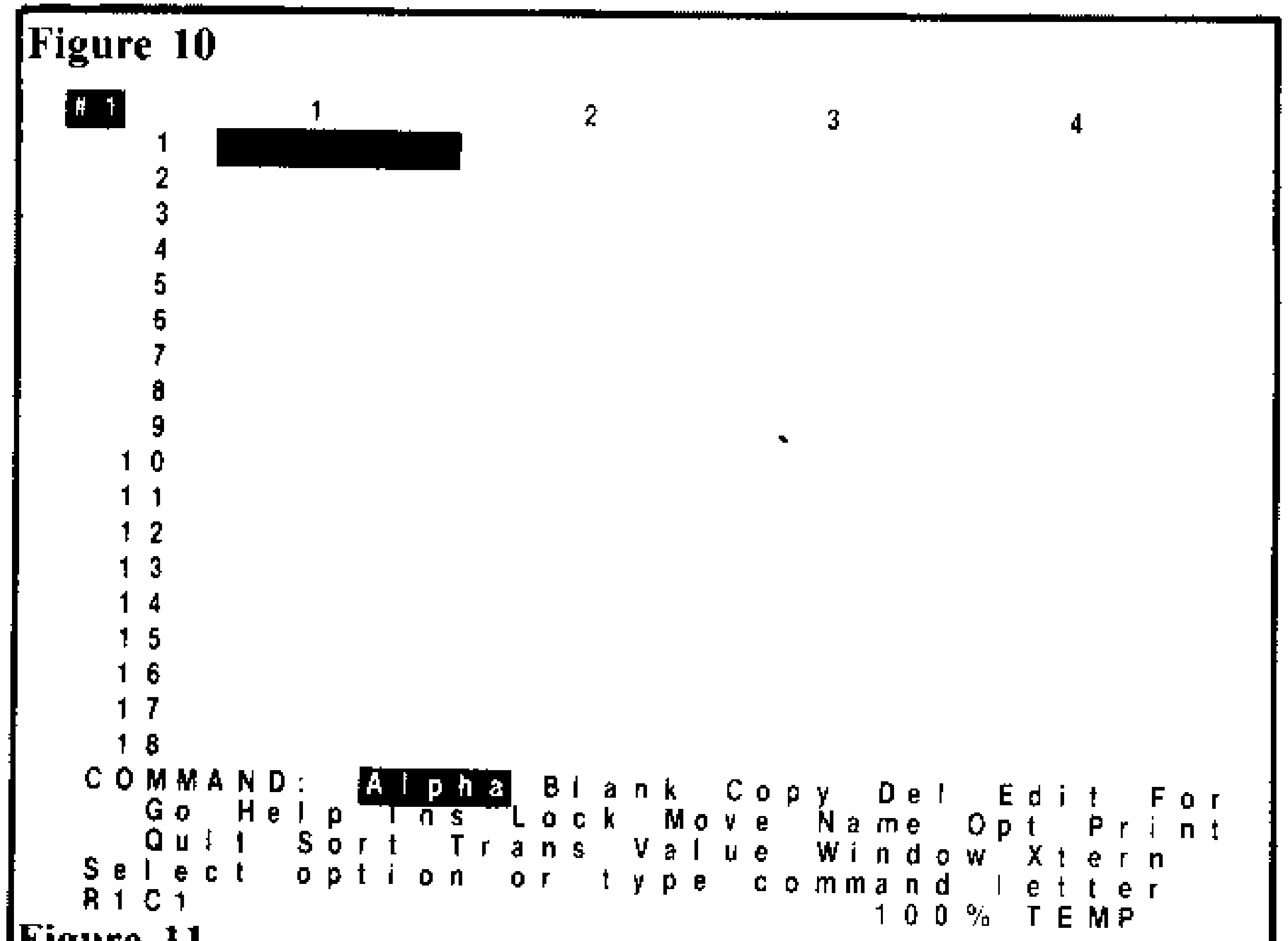
I have hardly mentioned the calculation power of *Multiplan*, but it is impressive. You can define a "cell" (a space on the worksheet) as a formula based on other cells and constants. Aside from the mundane +, −, *, and /, you can use such functions as average, sum, minimum, maximum, standard deviation, net present value, cosine, exponentiation, and square root. There are also logical functions such as IF and NOT, and table-oriented functions such as LOOKUP and INDEX. Whenever the value of a cell changes, *Multiplan* automatically recalculates any cells dependent on the changed cell. This automatic recalculation feature can be turned off, which is nice when you're changing many cells and don't want to wait for the recalculation after each change.

Despite all these useful features, there are a few things I don't especially like about the implementation of *Multiplan* on the TI-99/4A. For one thing, with just 40 columns on the display, you can only see up to 4 columns of the worksheet at a time (in most cases). Therefore, you spend a lot of time moving your screen-sized window around the worksheet. To move the window, you must use various combinations of control (CTRL) and function (FCN) keys with other keys, and I find myself becoming confused by all the different combinations. And when I'm also making heavy use of the SHIFT and ENTER keys, it can really get confusing. I suspect that this will improve with practice, but in the beginning it's difficult to use the correct keys. One final problem is that you can't *type ahead* at all; there is no keyboard *buffer*. As a result, you often have to pause and wait for the computer.

What You See

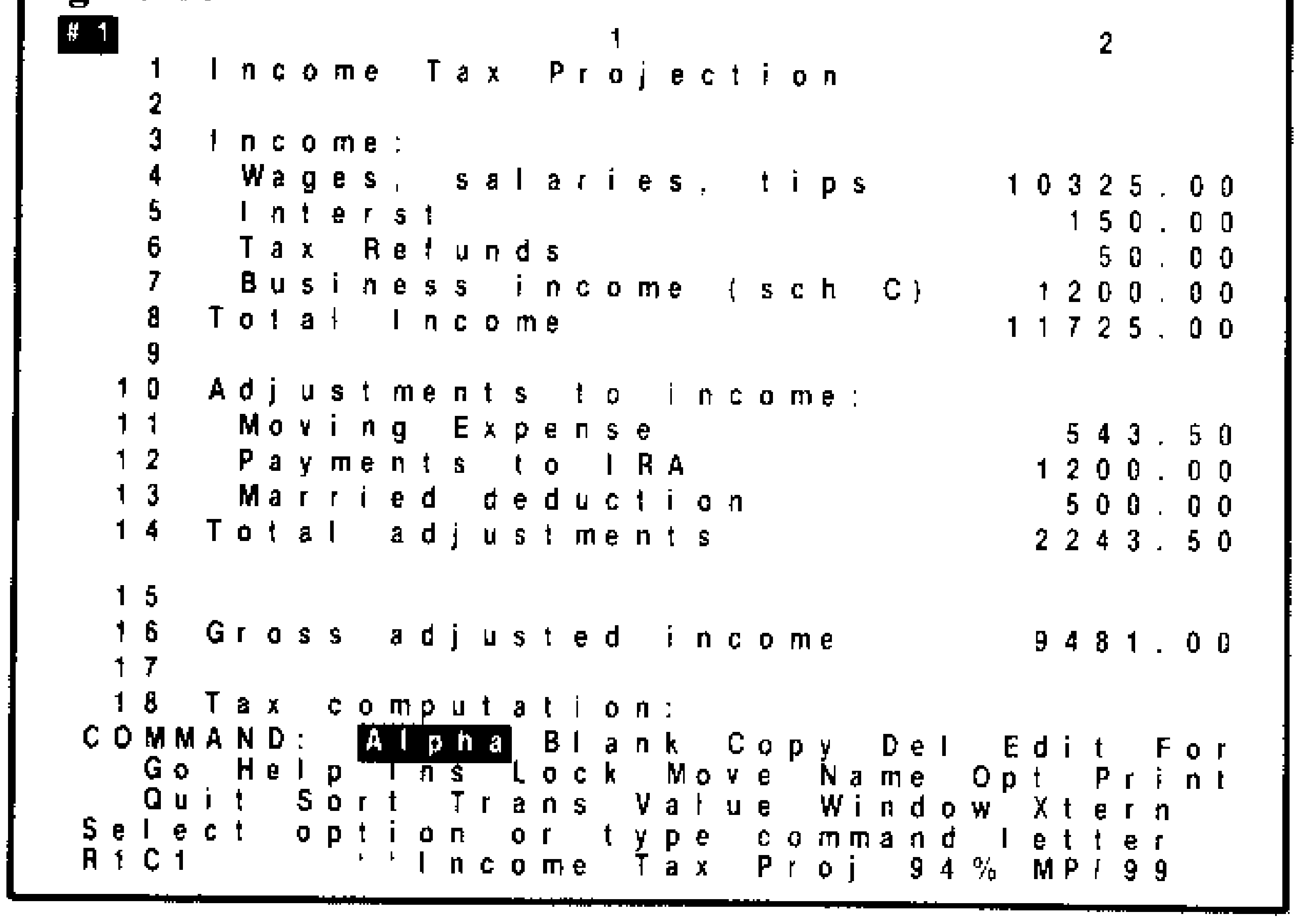
Figure 10 shows a blank worksheet as it appears when you first enter *Multiplan*. Notice the row and column numbers, the list of available functions, the percentage of space left to use, and the filename (TEMP). Figure 11 shows the upper portion of the income tax projection worksheet as it appears on the screen. Contrast this with Figure 3, which is the print-out of the same worksheet.

Figure 10



```
#1         1         2         3         4
  1
  2
  3
  4
  5
  6
  7
  8
  9
 10
 11
 12
 13
 14
 15
 16
 17
 18
COMMAND: Alpha Blank Copy Del Edit For
  Go Help Ins Lock Move Name Opt Print
  Quit Sort Trans Value Window Xtern
Select option or type command letter
R1C1
                             100% TEMP
```

Figure 11



```
#1                   1                2
  1 Income Tax Projection
  2
  3 Income:
  4   Wages, salaries, tips       10325.00
  5   Interst                       150.00
  6   Tax Refunds                    50.00
  7   Business income (sch C)     1200.00
  8 Total Income                  11725.00
  9
 10 Adjustments to income:
 11   Moving Expense               543.50
 12   Payments to IRA             1200.00
 13   Married deduction            500.00
 14 Total adjustments             2243.50

 15
 16 Gross adjusted income         9481.00
 17
 18 Tax computation:
COMMAND: Alpha Blank Copy Del Edit For
  Go Help Ins Lock Move Name Opt Print
  Quit Sort Trans Value Window Xtern
Select option or type command letter
R1C1      ''Income Tax Proj 94% MP/99
```

More To Come

This article is the first in a series of articles about *Multiplan*. In the next few issues we will dissect the models presented here. We hope to hear from you about your *Multiplan* questions, and will try to answer them in this magazine.

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In response to the late-February halt in shipments of the 99/4A due to a potential defect in the Model AC9500 power transformer sold with the unit (one of several transformers purchased by TI from outside vendors), Texas Instruments has started implementing a remedy at both the retail and consumer levels. 99/4A owners on TI's warranty-registration list will be mailed an adapter that goes between the line voltage outlet and the small-black-box transformer. The "Green Label Safety Check" sticker will be placed on safety-checked boxes in retailers' inventory by a TI task force. Consumer inquiries are being referred to toll free lines: 1-800-527-3550 or 1-800-858-4565.

IT'S ALL IN THE CHIPS

TI has recently commenced shipping its high-speed CMOS logic components, a move that portends the eventual growth of an extensive family, duplicating its current bipolar product line. When this low-power series finds its way into consumer computers, the industry can expect to see cooler running--and consequently smaller--products, as well as more powerful battery-operated portable products. On another front, TI's new high-density memory chips are also low power, and are eventually destined to find use in this low-end consumer mass market.

TI EXPANDS PARTICIPATION IN SHOWS AS MULTI-PRODUCT LINE READIES

Texas Instruments showed its new face to the hobbyist/professional community at the 1983 West Coast Computer Fair with six times the floor space it occupied at the 1982 event. Because the show was attended by just about all major microcomputer software firms, the increased visibility should result in winning over a substantial amount of additional third-party software and peripheral support to both the Lubbock- and Austin-based product lines.

ATARI LAYOFFS & OVERSEAS MOVE SIGNALS INTEGRATED MARKET RESPONSE

Atari's recent layoffs and announced production move to Asia represent an attempt to stay competitive with TI and Commodore by reducing labor costs. Both Commodore and TI have speeded up their R & D to produce machines that are more highly integrated--i.e, have increasingly fewer parts. This not only decreases labor costs (due to less handling of discrete components), but cuts material costs as well. Atari was forced overseas for cost reductions because it is not a vertically integrated manufacturer (e.g., makes its own chips) as are TI and Commodore. In response to Atari's move, we can expect to see even further levels of component integration from the two principal players--resulting in significantly more powerful and feature-laden machines at lower costs. In the forthcoming TI-Commodore integration battle, TI is expected to gain a considerable cost advantage as Commodore must shift from its own 8-bit to other firms' 16-bit microprocessors to match TI's performance factor. TI's advantage will result from Commodore's higher CPU cost when buying the 16-bit chips from such manufacturers as Zilog.

99'er Digest is a marketing information service for retailers, distributors, third-party vendors, sales representatives, industry analysts, and other TI-watchers interested in the home computing, personal computing, and portable computing markets in which Texas Instruments is present. The publication is issued biweekly and mailed First Class. Appropriate items of consumer interest are excerpted from the Digest in the monthly 99'er Home Computer Magazine. For subscription details contact: Emerald Valley Publishing Co., 1500 Valley River Drive, Suite 250, Eugene, OR 97401.

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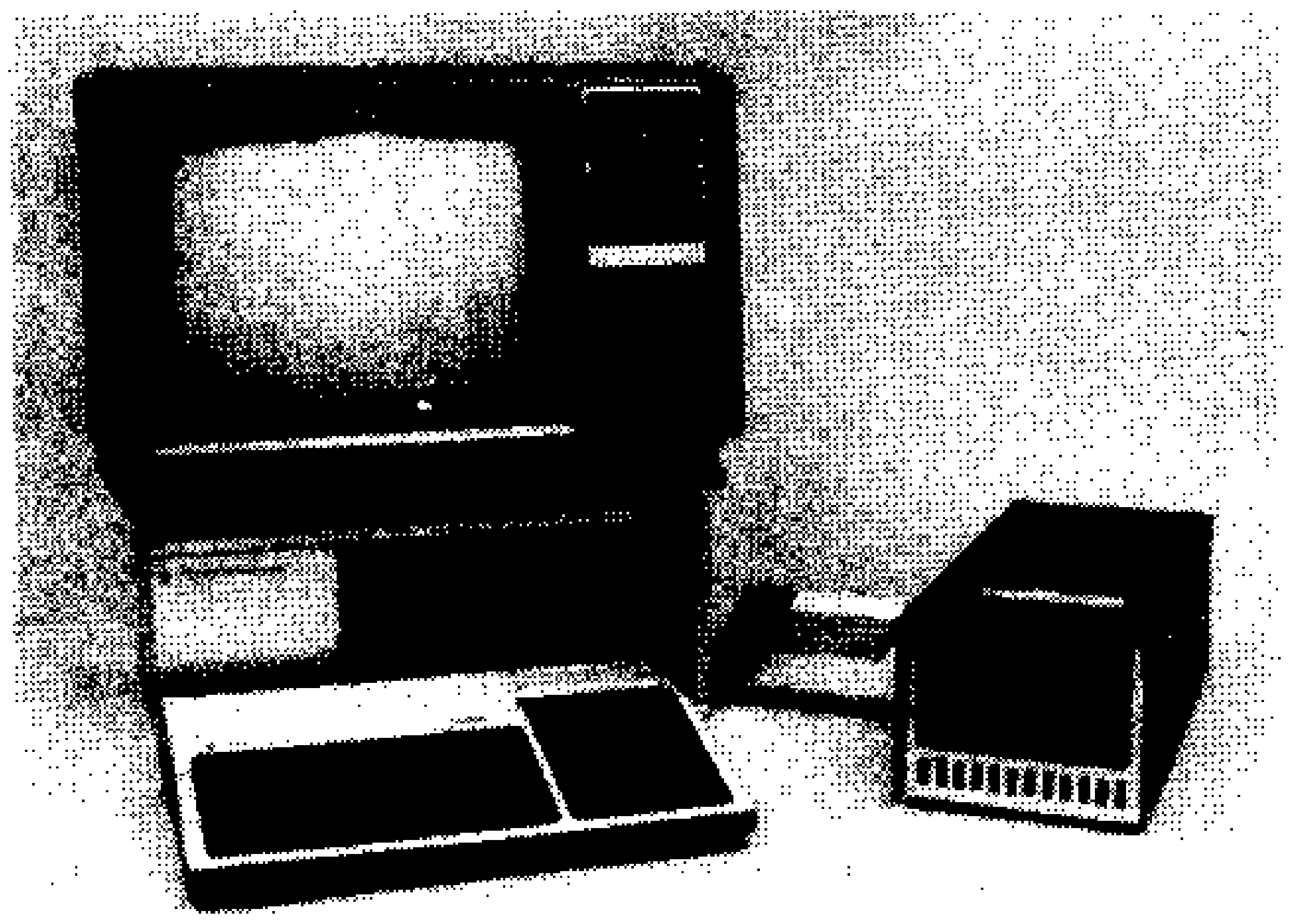

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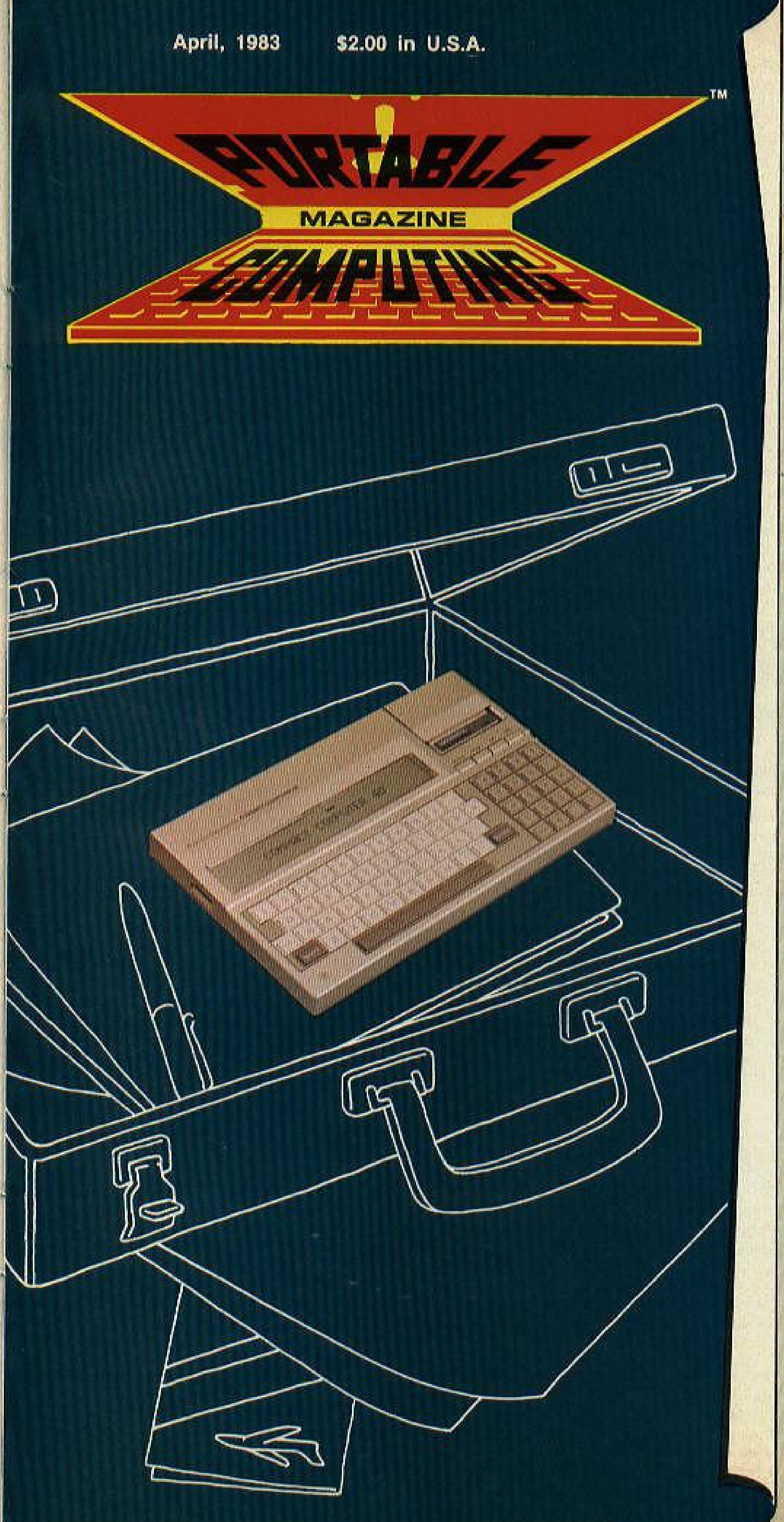

INTERVIEW

WITH Herb Shanzer

Manager, Calculator & Compact Computers Division, Texas Instruments, Inc.

By Gary M. Kaplan

PCM: At the Consumer Electronics Show in the summer of 1982 we saw the introduction of the TI-88, a hand-held calculator. And recently, TI announced the discontinuation of that product and the birth of a new Compact Computer line. What was the reasoning behind this?

HS: I think the reasoning is one in terms of a transition we are experiencing in the industry. It really does not cast any negative light on the TI-88 which I believe is an excellent product. Over the past few months, as we looked at industry trends, we saw a number of things happening. First, the TI-88 represented the upper end of the keystroke-programmable calculator market—a highly sophisticated tool for the highly sophisticated user. It also represented, for TI, a significant commitment to the software and after-market support of that product for a reasonable period of time. I think what made the 58 and 59 programmable family a successful product was not just the product itself, but the availability of the program modules and other related products.

The technological marketplace in general is one that changes rapidly, and we saw a very fast transition after the introduction of the TI-88. Use of BASIC-programmable, hand-held devices was supplanting the keystroke-programmable devices because of the difference in technology. When the first keystroke-programmable calculators came out, they were the only thing that offered some level of programmability at an approximate $250 price point. That was because both MOS chips and memory chips were so expensive that you really had to use a very efficient approach—keystroke programming—to enable you to deliver that level of capability. What's happened over the course of years is that memory chips and CMOS technology have improved to the point that you are able to offer a similar level of functionality in high-level computer language formats.

BASIC is a classical example of that. We found that for the sophisticated user who wants to do a lot of keystroke programming, after you reach a certain size program, use of a high-level language is much less cumbersome. Even though the high-level language is a lot less efficient to implement in the architecture of the machine (from a processor/memory viewpoint), it more than offsets that disadvantage for the user. So what happened in the marketplace was a great shift away from keystroke-programmable calculators into BASIC-programmable computers.

From our viewpoint, this represents a new market opportunity. I mean the 58, 59, TI-88 or the other various keystroke-programmable

PORTABLE COMPUTING MAGAZINE™

Portable Computing Magazine™ (PCM) is for all those interested in portable computing *machines* and portable computing *software*. Portable machine coverage includes machines from hand-held programmables on up to attache-sized computers that can be conveniently carried to and used on the job—providing portable computing power where needed. The magazine's software focus is on programs that run under the U.C.S.D. p-System, thus making them capable of being run on many different desktop computers. Software coverage encompasses the U.C.S.D. operating system itself, the programming languages that it supports (such as U.C.S.D. Pascal), as well as the applications programs written in these languages. Regular features include product reviews, tutorials on new product usage and programming, Letters to the Editor, and interviews with professionals in the dual worlds of hardware and software *Portable Computing*.

In each issue, one or more of the articles may reference or build upon the topics discussed in a previous article. It is therefore recommended that for maximum benefit and understanding, new readers obtain the appropriate back issues of *99'er Home Computer Magazine* in which PCM articles are contained.

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calculators represent tools—good tools, but you have to be knowledgeable to use them. The BASIC-programmable computer represents a tool to that person who is sophisticated enough to use it and a solutions machine to someone who is not sophisticated enough to understand how to program. Because in fact, you can build general purpose programs.

So we looked at the industry trend and decided that it would be a disservice to our users to bring out a product if we couldn't maintain an extensive commitment to it for a number of years. We just couldn't bring out the TI-88 one day and decide not to support it the next. We owe it to users to continue to develop software accessories and peripherals. And we would be doing a disservice to ourselves if we were spending our intellectual energies in that realm, as opposed to what we thought was the long-range realm of the general purpose hand-held, BASIC-programmable computer. We would also be doing a disservice to our customers, to move them on to a new product which was a nonstrategic and receding technology. So the decision we made—which was a difficult one—viewed the long-range strategic perspective both for our user base and the company. We decided to concentrate our energies and to concentrate our customer focus on the longer-range technology. That is the thought process that made us accelerate the work on the Compact Computer.

PCM: In all of your product literature the CC-40 is being billed as the first in a series of compacts. Can you tell us something about what is coming in this series of compact machines?

HS: I would like to discuss what is coming, in general—as opposed to specifics—because, as we discussed in the context of the TI-88, specifics have a habit of changing. I believe that the Compact Computer 40 is a computer *system*. It is a system that has the same set of attributes as an EDP system, a minicomputer system, or a personal computer system. It has a different price, different specific performance and functionality features, but the systems concept is the same. And if you look at any of those system histories, you find that each initial product ultimately begets *three* products. I'll just use an arbitrary time window of two years for an example. When product A comes out, within two years it begets three new products: (1) product B which is the same price as product A was, but (because of newer technology) does a lot more than product A did; (2) product C which does the same thing as product A did, but because of new technology, costs significantly less than product A did when it came out; and finally, (3) product D which is a product that costs more than product A did when it came out, but has a heck of a lot more capability and more performance per dollar than product A did.

That is the classic systems strategy which we plan on following. As I said, the two year time period that I used is an arbitrary one. I'm not saying that we're not going to have products out before two years from now, because we will. And I'm not even sure in what order we are going to bring them out. I think this is what people ought to expect from a computer systems family—in that B, C, and D each beget two or three brethren, and a Christmas tree grows from that. The challenge is to *not* put too many branches on the tree. And the challenge also is to make sure that the price points and the customer choices between B, C, and D are explicit. You really want to make B, C, and D sufficiently different from each other, so that you hit a broader spectrum of applications and you make the choice from the consumer's viewpoint readily apparent. That is what we mean when we say the CC-40 is "the first of the series."

PCM: Do you see just an applications market? Or do you also envision a market with products and support for the more technical user—the person who wants to get into the machine, and make it do what he or she wants it to do?

HS: I see *both* markets. The product is appropriate for an applications market, and we have very extensive plans to position it in this area. In fact, our marketing slogan is "Solutions Anywhere." We really believe that the positioning of it as an applications-oriented solutions machine is a key portion of the market thrust. However, it certainly is also appropriate for the technical user, and we plan on supporting that technical user in a fashion that is commensurate with his abilities.

> **". . . a brand new opportunity exists for people who can't afford $2500 for a personal computer but who can afford $250 for a Compact Computer."**

We think that this machine has a "split personality." In one sense it is a new approach (in a new price-point range) to attacking the same kinds of problems that personal computers attack. And the personal computers attack the same kind of problems that mini computers attack, and the mini computers attack the same kind of problems that the EDP systems attack—all at different prices, with different performance features. In addition to that, it is also a high-level, keystroke-programmable calculator replacement.

This usage is a different one in the sense that the machine is used by the knowledgeable person who is capable of understanding the intricacies of the equipment and capable—as long as you explain what is in there—of using it satisfactorally. And certainly, we believe that this is an important marketplace. It is, frankly, a marketplace that we learn a lot from. So I think it is important from that viewpoint, in addition to the volume that it represents. And it is important that we serve that marketplace because it keeps us on our toes. If the machine isn't capable of servicing that marketplace, it probably doesn't have the right power built into it upon which you can build applications.

The only difference between the technical and the solutions marketplaces is that the technical marketplace builds its *own* solutions. For the solutions marketplace, *TI* builds the solutions and markets them. But both markets require the same very high-quality, high-capability functionality base to build on—the base hardware system. For example, we will be making available, in assembly language, a package and various other software offerings that are really catered to the computer-tool-level user. It would be impossible for us to document those in a sufficiently sanitary condition for them also to be totally useful to the solutions-oriented user. And it is our value judgment that, rather than restrict the flexibility of those features, or hide the capabilities that we can't explain in very simple terms, we would prefer to point certain of those products at the knowledgeable user who is capable of taking a relatively cursory level of information and documentation and running with it. We think that is the value judgement in the *user's* best interest. So that is really our strategy.

PCM: TI's most recent ad showed how the Compact Computer won't "take over your desk." Can you give us some examples of how a Compact Computer can perform some of the applications or functions of a desk-top unit?

HS: Sure. I think that here you have to keep in mind the flexibility of being able to do a job, the performance factor of how you do that job, and the cost or the price point that one is going at. There is absolutely no way a compact sitting on a desk with a simple multiple-line LCD display and serial-oriented Wafertape device is going to do certain applications as flexibly, as well, and as fast as a personal computer with a full CRT and a mini-floppy or hard Winchester storage device. The system that I just described has between a 5- and 10-to-1 difference in price. While it may not have the same 5- or 10-to-1 difference in capability, it certainly has a 2- or 3-to-1 difference.

But I think that the issue here is as follows: Size is an advantage. We believe in the Compact Computer's place for a number of reasons. First of all, it can sit on your desk and not take up a lot of room. When you want to use it, it's there available for you. When you don't want to use it, you can ignore it. You can't say that about a PC with a CRT on top of it, a disk next to it, a printer next to it, and lots of cables.

Second, the smallness gives you the ability to take the same machine, throw it in your attache case, and bring it home. Or you can throw it in your suitcase when you're on a business trip somewhere and want to use it in your hotel room. We believe that the primary advantage of its size is its *transportability*. We avoided calling it "portable" because portable has the connotation of walking down the street while programming it. While that is certainly feasible, we are not sure about how *likely* it will be. So it is really a personal machine in the sense that you can bring it with you wherever you go, and use it whenever you want.

"If you deliver the right general purpose tool to people at the right price point, they will use it in ways that you never imagined."

There's another aspect of the size issue that is quite favorable with the personal computer. In terms of applications, you can do word processing, spreadsheet analysis, data communications, run specific applications in real estate, electrical engineering, mathematics, or a whole set of specific programs—the same kinds of programs that you run on your personal computer. Each of those individual programs may have a different set of operational characteristics on the small machine than they have on the large one. Certainly, the characteristics of the display and random file access will probably be less well done on the small machine than on the large personal computer.

On the other hand, the Solid State Software cartridge which replaces multiple overlays coming off floppy disks may mean that your execution speed is *higher* on the small machine. Because you don't have to wait to load the overlays, and you don't have the floppy seek time. In essence, you have the entire applications code resident in memory and operating the whole thing at processor speeds.

There are pluses and minuses from a performance standpoint. It is a complex issue. But you have an opportunity to solve the *same* kinds of problems at a price point that is perhaps 20% (from a systems viewpoint) the price of the larger personal computer. This offers *secondary* personal machines to people who already own personal computers. But much more importantly, a whole brand new opportunity exists for people who can't afford to pay $2500 for a personal computer, but who *can* afford to pay $250 for a Compact Computer. So we are bringing them a whole set of applications help that they never would have gotten without the Compact Computer marketplace.

PCM: Can you define for us what you actually mean by a "transportable" or a "compact computer?" And is there another term that perhaps we should be considering in conjunction with these terms?

HS: That is a tough question. We have done a lot of struggling with it during the design of the product and in deciding what to call the product. We have come to the conclusion that the important aspect of this product is *compactness*, and the compactness has two virtues: First of all, the machine is small, unobtrusive, and has relatively

neat cable management which is a direct function of the battery operation. The fact that it is compact and the fact that it is battery operated also allows you to carry it around. Again, we feel the primary emphasis is the ability to carry it from place to place and use this machine at a number of different places—at home, on the road, in the office, etc. We're not of the opinion that many people want to use this as a portable machine in the context of actually walking around and carrying it while using it. It is certainly possible that there are a number of people who will use it that way. In our mind, in terms of the quantities of potential users, this is a relatively small marketplace. And candidly, it turns out that the ability to make it portable comes *free* by virtue of the fact that it is compact. If we had to add cost to make it portable, we probably would not.

PCM: Do you foresee a lot of "field use"—that is, data acquisition and transfer to larger machines such as the 99/4A Home Computer with floppy disks?

HS: I believe the Compact Computer is a good general-purpose tool that lends itself intellectually to that kind of use. I think that people will figure out how to use it that way. I believe there will probably be a large future expansion of the marketplace. If you ask me to imagine specific applications and specific areas where it will be likely to happen first, I have to beg off on that because we have found that the users are a heck of a lot more imaginative than the manufacturers. That is true in the personal computer space. I don't think that Apple ever thought they would be selling to big companies when they started off originally selling to hobbyists. I don't think that mini-computer manufacturers ever envisioned themselves as business machine manufacturers. They envisioned themselves as process-control people to start with. It was the users who caused that. If you deliver the right general purpose tool to people at the right price point, they will use it in ways that you never imagined. The companies who win are the companies who develop the right tools. I think that one thing is important here: the computer, because of its programmability, is a lot more of a general purpose tool than a calculator. The concept of "general purpose" is a very key thing.

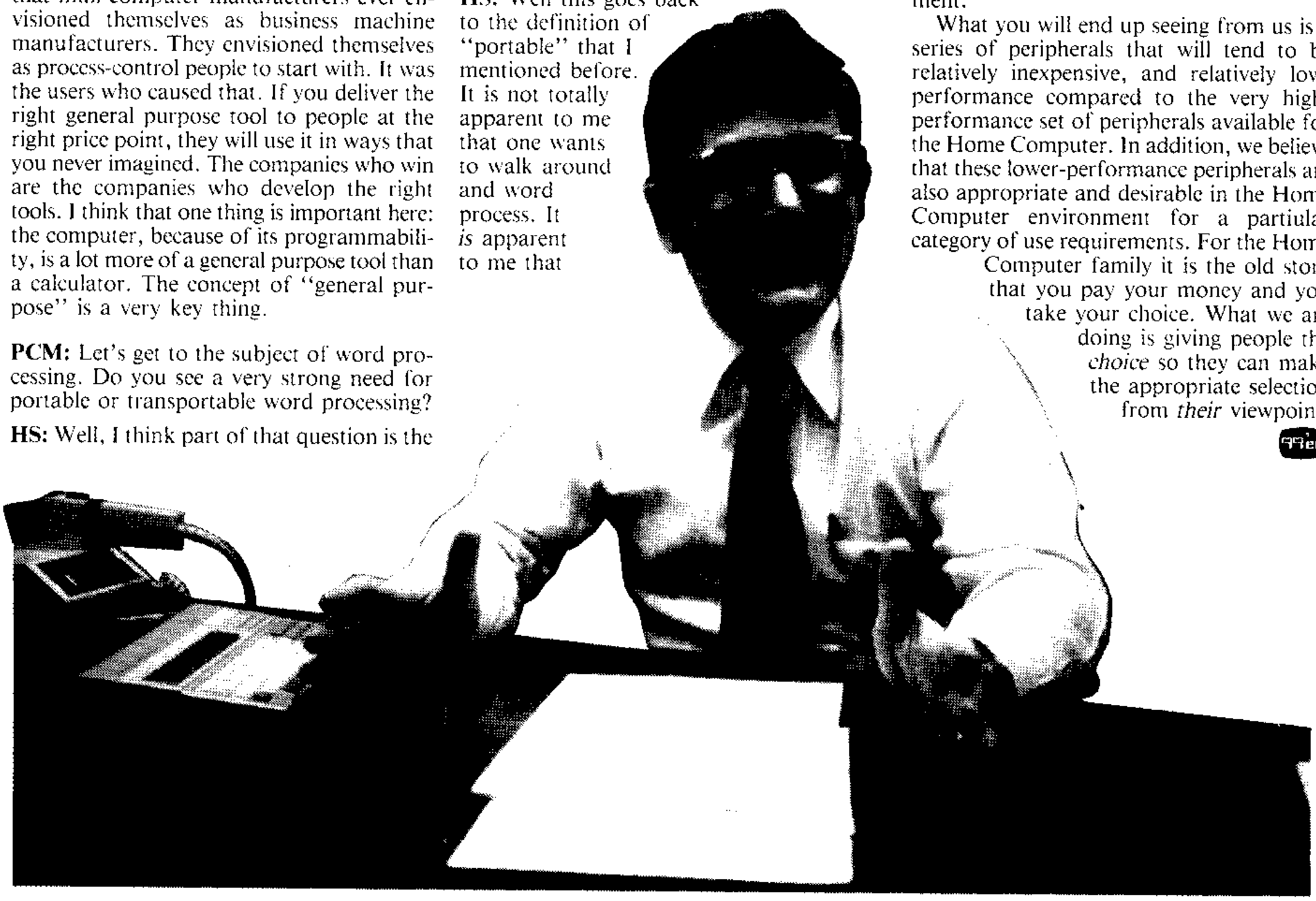
PCM: Let's get to the subject of word processing. Do you see a very strong need for portable or transportable word processing?

HS: Well, I think part of that question is the psychological aura that surrounds the terminology "word processing." Most people think of letters or contracts produced on computers by secretaries. When I use the terminology "word processor," I am really talking about the ability to generate text and then change it conveniently before permanently doing something to it—archiving it on a file, sending a message over a line, or printing it out on a piece of paper so that you can mail it to somebody. Not only the secretary does word processing, but an executive does memo writing, and a housewife or a home owner writes letters to the bank or the mortgage company. So I think that the need to be able to generate text conveniently, edit it, and then send it somewhere is a universal one. And to that extent, I believe that it is what you would call a "portable need"—it is not only needed in the office, but it is needed by everybody.

> **"It does not do any good to have a $250 computer if it costs $750 for a peripheral . . . So we decided that portability, compactness and low cost were to be the key ingredients."**

PCM: Do you perceive a need for word processing "on the go"—when you are not at a facility where you can plug into electric current found at home or at any office? In other words, is it needed while in the car, train, or on an airplane while traveling?

HS: Well this goes back to the definition of "portable" that I mentioned before. It is not totally apparent to me that one wants to walk around and word process. It *is* apparent to me that one wants to be able to throw a Compact Computer in one's attache case, bring it to a hotel room and maybe go through one's "in-basket" because there is an extra hour to generate some memos. I don't care if you use the battery feature in the motel room, or you find your AC adapter and plug it into the wall. The fact remains that you had this small thing that you could throw into your attache case to bring with you, so that you had the opportunity to use it. So I would say it's more a "transportable" view.



PCM: Can you shed some light on the significance and development of compact peripherals?

HS: As I have mentioned before, we view the Compact Computer family as a general-purpose computer family. And all general-purpose computers require peripherals to get reasonable usage from an applications viewpoint. The peripherals had to, obviously, be of the same compact battery-operated genre as the basic machine or there would be a discontinuity. We also felt that we would very much like to have the peripherals be in the same kind of price range as the machine. It does not do any good to have a $250 computer if it costs $750 for a peripheral! So in designing the peripherals, we decided that portability, compactness, and low cost were to be the key ingredients. I would make the comment that we believe low cost is a higher priority. We are in the business of being able to supply an applications solution engine to people who could not afford a more expensive one. And therefore, I would like to get them a usable peripheral at an affordable price. If I have to make it *slower* to make it affordable, I think that is a valid value judgment.

What you will end up seeing from us is a series of peripherals that will tend to be relatively inexpensive, and relatively low-performance compared to the very high-performance set of peripherals available for the Home Computer. In addition, we believe that these lower-performance peripherals are also appropriate and desirable in the Home Computer environment for a partiular category of use requirements. For the Home Computer family it is the old story that you pay your money and you take your choice. What we are doing is giving people the *choice* so they can make the appropriate selection from *their* viewpoint.

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The

FIFTEEN PUZZLE

By Roger B. Kirchner

Contributing Editor

Thirty years ago the *Fifteen* puzzle was almost a national craze. The typical version consisted of a plastic frame with fifteen numbered plastic squares and one blank space. Only the squares adjacent to the blank space were movable—the object being to move the squares to achieve a given pattern. Sometimes enormous prizes were offered for patterns impossible to produce. (I owned a "deluxe" version of the puzzle in which all patterns *could* be obtained because it had a secret removable part, allowing permutation of the squares. I amazed my friends with it.)

Simulating this puzzle with LOGO presents an interesting challange: How can we represent the parts of the puzzle? Clearly, the frame can be constructed from tiles, and the numbered squares made up of sprites; but how can we represent positions and show the operations of the puzzle?

Let's give the name *Fifteen* to the task of implementing the puzzle. This abstract naming of a process seems to allow one to think about it more concretely. *Fifteen* has to accomplish two tasks: representing the puzzle, and manipulating it. Let's call these tasks SETUP and SOLVE. Then the definition of Fifteen will be:

```
TO FIFTEEN
SETUP
SOLVE
END
```

Two versions of SOLVE will be given—one using keys on the console, the other using a joystick.

SETUP

To approach the problem of displaying the puzzle, we need to know some facts about the screen.

Recall that a tile is an 8×8 pixel square, and a sprite shape is a 16×16 pixel square. The screen is divided into 24 rows (0 through 23) of 32 columns (0 through 31) of character positions. You can display a tile in any of these positions using the primitive PUTTILE (PT), and can position a sprite using SXY to set its x and y coordinates. The coordinates of a sprite are measured with respect to one of the four center pixels, the upper left corner of the character in column 16 and row 12. The sprite's coordinates are the coordinates of the pixel *just above* the upper left corner of the sprite. A sprite at "HOME," with coordinates (0, 0) is thus just below covering four tile positions. A sprite with coordinates (0, 1) exactly covers four tiles.

Let's center the puzzle on the screen. The frame should be a 10×10 tile square, for then

Continued on p. 50

Introduction

LOGO Times is an information resource for anyone interested in participating in the creation of their own *personal* language—one that will easily allow them to communicate with a computer in a totally new audiovisual realm of applied imagination, exploration, and self-discovery. The articles on these pages concern the use of the new TI LOGO language, but readers do *not* need any additional software or equipment (or even a computer) to understand and learn from the material presented here.

If readers want to actually *experience* a TI LOGO environment, they will need either a TI-99/4 or TI-99/4A computer, the Expansion Memory peripheral, and TI LOGO Command Cartridge. A disk drive, although convenient to have, is *not* required; a user's work may alternately be saved on cassette tape, printed out on the TI Thermal Printer, or hand copied into a notebook (for later re-keyboarding).

In each issue, one or more of the articles may reference or build upon the topics discussed in a previous article. It is therefore recommended that for maximum benefit and understanding, new readers obtain the appropriate back issues of *99'er Home Computer Magazine* containing *LOGO Times* articles.

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there will be a one-tile border around the sixteen sprites. Using a paper with ruled squares as an aid, we find that the frame should use character positions with rows from 7 to 16 and columns from 11 to 20.

Our first problem is to display the frame. Following are three methods. Try them out to see which is the quickest.

```
TO INITFRAME1
MAKE "R 7
REPEAT 10 [MAKE "C 11 REPEAT 10 [PT 96
  :C :R MAKE "C :C + 1] MAKE "R :R + 1]
END

TO INITFRAME2
FOR "R 7 16 [FOR "C 11 20 [PT 96 :C :R] ]
END

TO INITFRAME3
TELL [11 12 13 14 15 16 17 18 19 20]
FOR "I 7 16 [EACH [PT 96 YN :I] ]
END
```

The FOR command can be defined by:

```
TO FOR :VAR :LO :HI :ACTION
IF :LO > :HI THEN STOP
MAKE :VAR :LO
RUN :ACTION
FOR :VAR :LO + 1 :HI :ACTION
END
```

Which version do you prefer? Which is easiest to understand? (Note: Tile 96 will be invisible because it doesn't have a pattern. To see the frame develop, first execute TELL TILE 96 SC [1 1].)

The first version is the most straightforward, using only LOGO primitives. The second and third use a FOR command which you might find useful in other procedures. Study the third version until you see how EACH is used to effect a kind of "FOR" command.

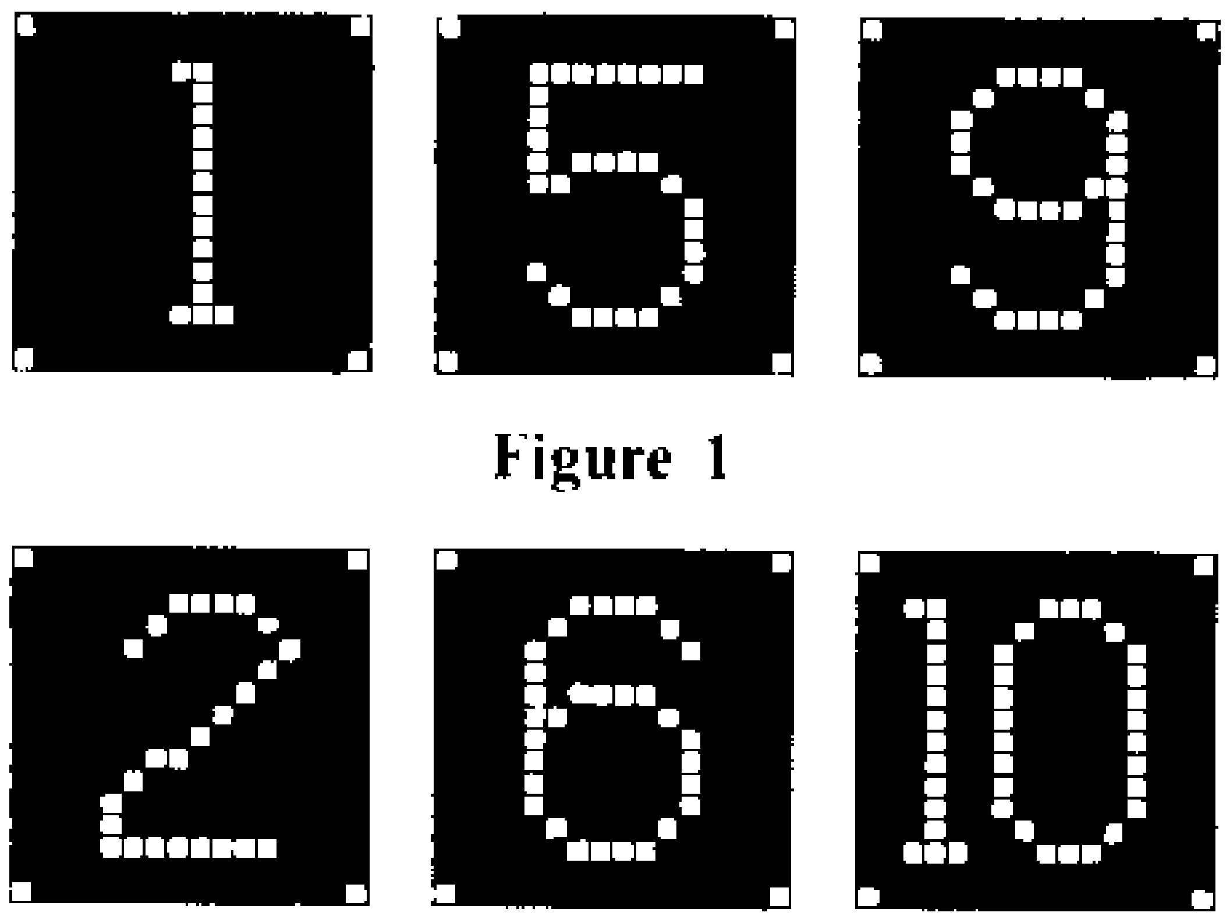
Figure 1

Next, we need shapes for the numbered squares. Some possibilities are drawn in Figure 1. Use MAKESHAPE to store shapes 6 through 20. Leave shape 21 clear. The sixteen squares of the puzzle will be represented by sprites 0 through 15. These sprites will initially carry shapes 6 through 21.

It will be helpful to have operations which output the row and column numbers for a given sprite. Let's number the rows and columns 0 through 3, and define ROW and COL by:

```
TO ROW :X
OUTPUT :X / 4
END

TO COL :X
OUTPUT :X - :X / 4 * 4
END
```

The row number of a sprite is just the integer quotient of its number divided by 4. Its column number is the remainder of its number after division by 4.

We want to position the sprites over the inner tiles of the frame. The x and y pixels' coordinates of the upper left corner of the frame are (-40,40), so the pixel coordinates of the upper left corner sprite should be (-32,32). This means that this sprite should be given coordinates (-32,33). The other sprites can be located relative to this sprite. We define INITSQS to position the sprites and assign initial shapes:

```
TO INITSQS
MAKE "X0 (-32)
MAKE "Y0 33
TELL  [0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15]
EACH [SXY :X0 + 16 * (COL YN) :Y0 - 16
  * (ROW YN)]
EACH [CARRY YN + 6]
END
```

INITFRAME and INTISQS will position the tiles and sprites, and assign shapes to the sprites, but will not cause anything to appear on the screen. Colors must be assigned to the tiles and sprites. We will define SETUP in such a way that a puzzle appears, fully formed:

```
TO SETUP
VANISH
CS
PRINT [THE FIFTEEN PUZZLE]
TELL TILE 96 SC [0 0]
INITFRAME 3
INITSQS
TELLTILE 96 SC [1 1]
TELL [0 2 4 6 8 10 12 14]
SC :ORANGE
TELL [1 3 5 7 9 11 13 15]
SC :WHITE
MAKE "BLANK 15
END

TO VANISH
TELL :ALL SC 0 SY 97
END
```

If the shapes have been defined, executing SETUP will display the puzzle in "solved" position, with the odd-numbered squares colored white, and the even-numbered squares colored orange. The numbers will be black, taking their color from the underlying frame. Sprite 15 carries the blank shape. The value of BLANK is set to 15, anticipating that we will need to know the sprite number of the blank square. VANISH will make all sprites invisible.

SOLVE

We have two important things to decide: how to enter moves and how to accomplish them.

It is natural to use the arrow keys, E, D, X and S to enter moves. Let's suppose that we want a square to move up if we press E, to the right if we press D, down if we press X, and to the left if we press S. Let's also cause the procedure to stop if we press Q, but ignore other keys. We write a definition for SOLVE:

```
TO SOLVE
PRINT [PRESS E, D, X, S, OR Q]
1:
MAKE "KEY RC
TEST MEMBER? :KEY [E D X S Q]
IFF GO "1
IF :KEY = "E THEN MOVEUP
IF :KEY = "D THEN MOVERIGHT
IF :KEY = "X THEN MOVEDOWN
IF :KEY = "S THEN MOVELEFT
IF :KEY = "Q THEN STOP
GO "1
END
```

MEMBER? is a most useful function. It checks whether a given item is in a list.

```
TO MEMBER? :X :L
IF :L = [ ] THEN OUTPUT "FALSE
IF :X = FIRST :L THEN OUTPUT "TRUE
OUTPUT MEMBER? :X BF :L
END
```

Now we must decide how to move the numbered squares. Although it seems "obvious" that we must move the sprites, this is not the case. If we move the sprites, we have to keep track of where they are; it is simpler to leave them where they are, and change their shapes. An advantage of this method is that the location of each sprite is determined by its number. Suppose we know the sprite number of the blank square. Can you determine the sprite numbers of the adjacent squares? For example, sprite 15, is initially blank. What is the sprite number of the square 12 just above it? What is the sprite number of square 15 to the left?

Suppose that sprite 15 is blank, and we want to move the number on sprite 11 to sprite 15. This can be simulated by saving the shape and color of sprite 11, setting the color of sprite 11 to 0 (transparent), and then assigning the shape and color just saved to sprite 15. Nothing has moved, but it will appear that the squares have changed.

In SETUP, :BLANK was used to name the sprite which is initially blank. Let's use :NEXT to name the sprite whose shape is to be moved. Using MOVE to name the process of moving the shape of :NEXT to :BLANK, we define:

```
TO MOVE
TELL :NEXT
MAKE "S SHAPE
MAKE "C COLOR
SC 0
TELL :BLANK
SC :C
CARRY :S
MAKE "BLANK :NEXT
END
```

MOVE saves the shape and color of sprite :NEXT, and then makes it blank by setting its color to 0 (transparent). Then the shape and color are assigned to sprite :BLANK, and BLANK's value is set to :NEXT.

All that remains are the procedures for actually moving the squares. These have already been named in SOLVE:, MOVEUP, MOVERIGHT, MOVEDOWN, and MOVELEFT.

Suppose we want to move a square up. This can be done only if the blank square is not in the last row. That is, we must check that ROW :BLANK <3. Then we must determine the sprite number of the square just below the blank square. That is :BLANK +4. The definition of MOVEUP can be:

```
TO MOVEUP
TEST ROW :BLANK < 3
IFF STOP
MAKE "NEXT :BLANK + 4
MOVE
END
```

The definitions for the other MOVE procedures are similiar; try writing them yourself before reading on.

```
TO MOVERIGHT
TEST COL :BLANK > 0
IFF STOP
MAKE "NEXT :BLANK - 1
MOVE
END
```

```
TO MOVEDOWN
TEST ROW :BLANK > 0
IFF STOP
MAKE "NEXT :BLANK - 4
MOVE
END
```

```
TO MOVELEFT
TEST COL :BLANK < 3
IFF STOP
MAKE "NEXT :BLANK + 1
MOVE
END
```

Now we have implemented the *Fifteen* puzzle. The last thing to do is to write a HELP procedure to give instructions (see listings). Now it's time to play. In manipulating the puzzle, note that you can work ahead, as keystrokes are saved in a buffer. See how many moves you can think ahead. Which of the patterns in the problems below can you achieve?

Gamesters may find it easier to manipulate the puzzle with a joystick. Although originally undocumented, JOY 1 will output one of the following values depending on the position of joystick 1:

```
2   6   10
1   5   9
0   4   8
```

If you want to use a joystick, modify the definition of SOLVE to:

```
TO SOLVE
1:
MAKE "K JOY 1
TEST MEMBER? :K [6 9 4 1]
IFF GO "1
IF :K = 6 THEN MOVEUP
IF :K = 9 THEN MOVERIGHT
IF :K = 4 THEN MOVEDOWN
IF :K = 1 THEN MOVELEFT
GO "1
END
```

You might also consider entering the following procedure to print the instructions:

```
TO HELP
CS
PRINT [FIFTEEN PUZZLE]
PRINT [ ]
PRINT [ENTER "FIFTEEN".]
PRINT [THEN PRESS]
PRINT ["E" TO MOVE SQUARE UP]
PRINT ["D" TO MOVE SQUARE RIGHT]
PRINT ["X" TO MOVE SQUARE DOWN]
PRINT ["S" TO MOVE SQUARE LEFT]
END
```

As an extra project, see if you can add a "secret" command which allows you to exchange the shapes on two adjacent squares. Then you too will be able to amaze your friends by obtaining any pattern you want.

Problems

1	3	5	7		1	2	3	4		4	3	2	1
9	11	13	15		12	13	14	5		8	7	6	5
2	4	6	8		11	□	15	6		12	11	10	9
10	12	14	□		10	9	8	7		□	15	14	13
1	5	9	13		□	2	3	13		2	4	6	8
2	6	10	14		15	11	10	8		10	12	14	□
3	7	11	15		9	7	6	12		1	3	5	7
4	8	12	□		4	14	5	1		9	11	13	15
1	2	3	4		1	8	9	□		4	3	2	1
8	7	6	5		2	7	10	15		5	6	7	8
9	10	11	12		3	6	11	14		12	11	10	9
□	15	14	13		4	5	12	13		13	14	15	□

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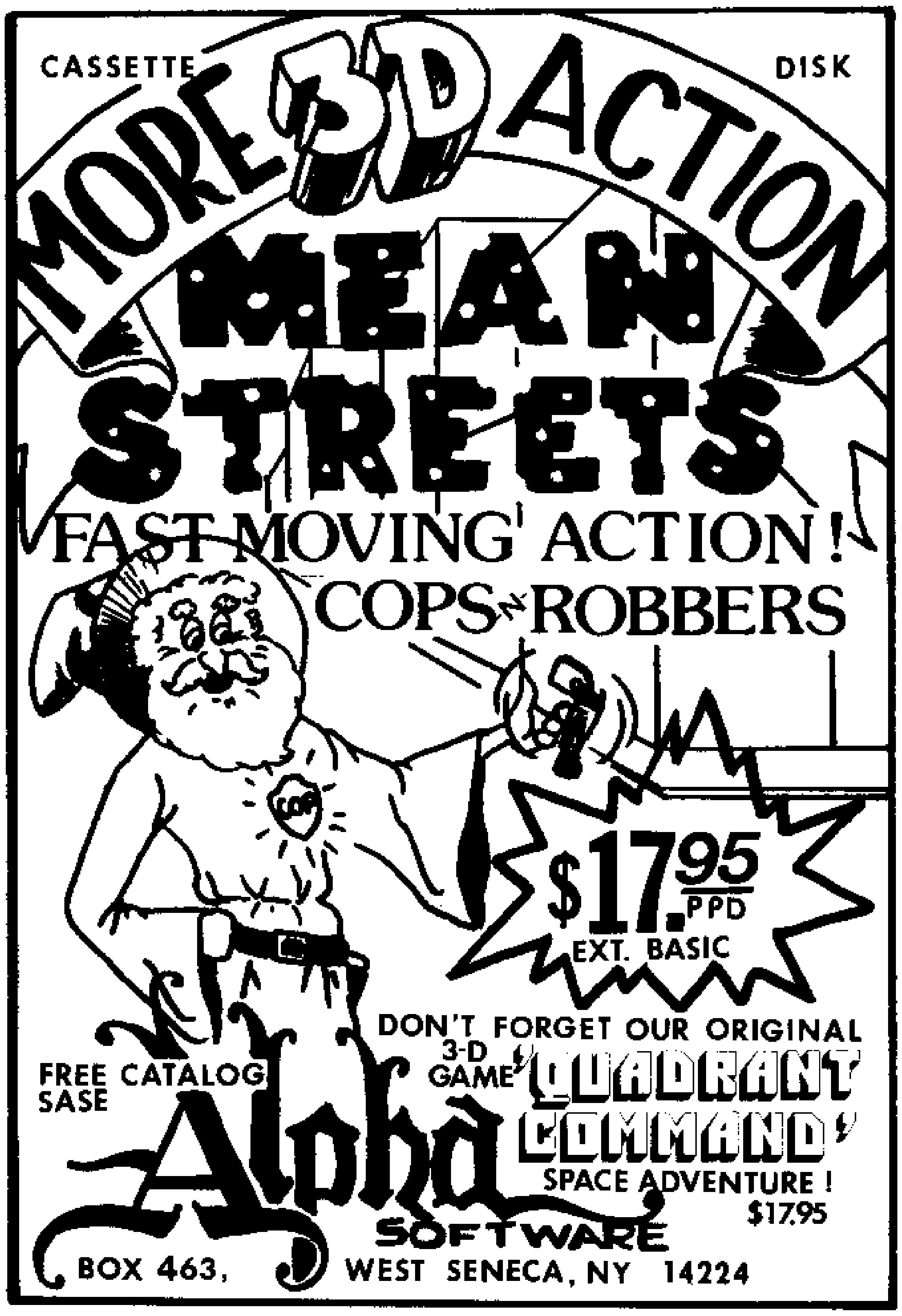

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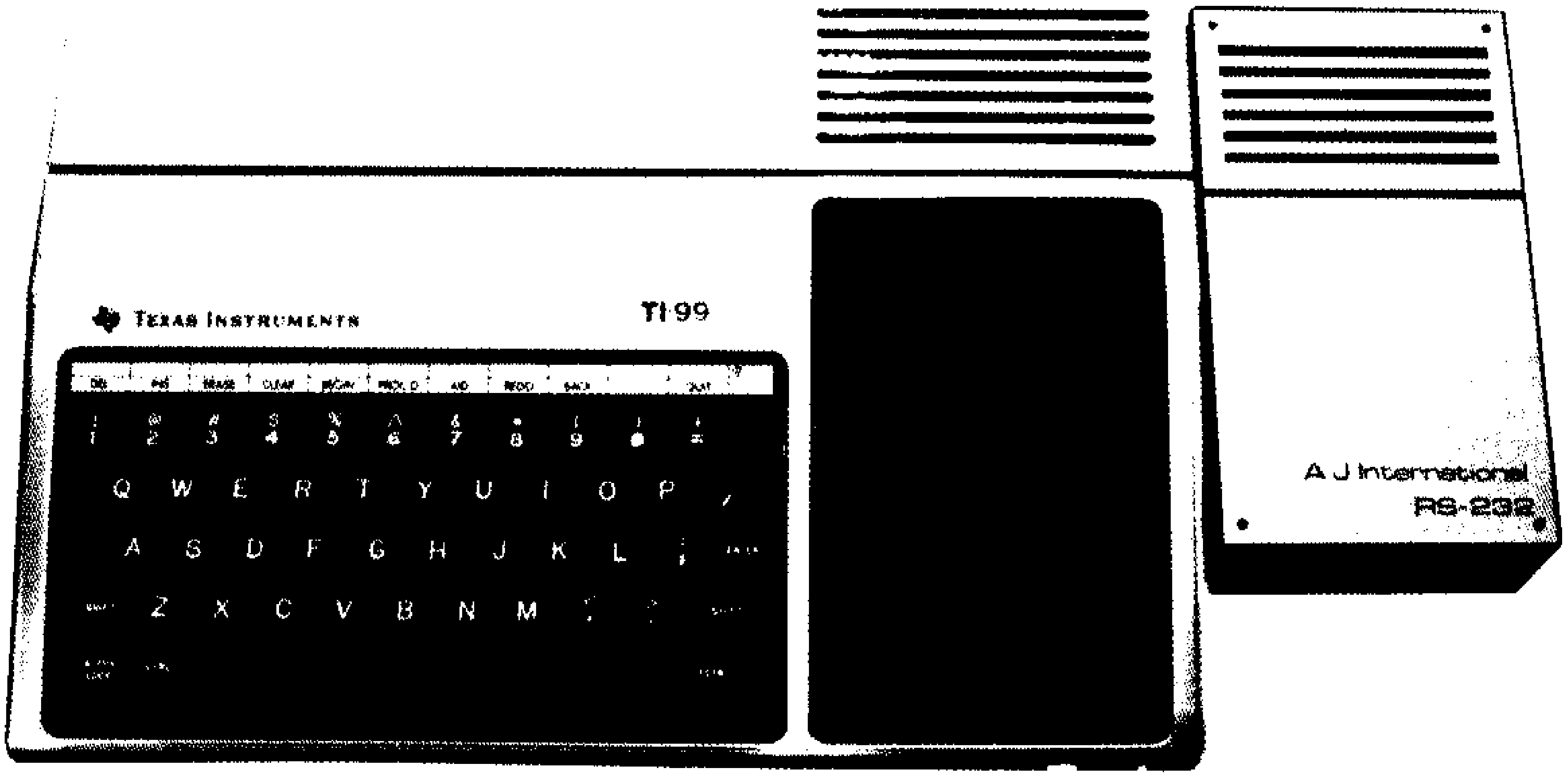

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GIANT & DWARFS . . . from p. 24

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```
100 REM ********************
110 REM * GIANT AND DWARFS *
120 REM ********************
130 REM BY B. A. TRAVER
140 REM 99'ER VERSION 2.6.1XB
150 REM
160 REM
170 CALL COLSCHEME(12,2):: DISPLAY
     AT(10,7):"GIANT AND DWARFS:":
    :"      AN ORIGINAL PROGRAM"
180 DISPLAY AT(14,8):"BY B.A. TRAV
    ER"
190 REM INITIALIZE
200 DIM R(8),C(8),SR(8),SC(8),Z(8)
    ,C1(4),C2(4),T(10)
210 FOR I=1 TO 8 :: READ R(I),C(I)
    :: NEXT I
220 DATA 11,3,5,9,17,9,11,15,5,21,
    11,21,17,21,11,27
230 FOR I=1 TO 8 :: SR(I)=8*R(I)-7
     :: SC(I)=8*C(I)-7 :: NEXT I
240 FOR I=1 TO 4 :: READ C1(I),C2(
    I):: NEXT I :: FOR I=1 TO 10 :
    : READ T(I):: NEXT I
250 DATA 6,8,13,4,7,10,5,6,110,139
    ,165,220,277,330,440,554,659,8
    80
260 RANDOMIZE :: DEF RN(I)=INT(I*R
    ND)+1
270 GOSUB 2010
280 REM DEFINE CHARACTERS
290 CALL CHAR(64,"000000303000303"
    ):: CALL CHAR(94,"003048081020
    002")
300 CALL CHAR(96,"0000010101010305
    0501020203000000000080C08080C0
    A0A080404060000000")
310 CALL CHAR(100,"07050704077FFFC
    7C7E7C70706061E1EE0A0E020E0FEF
    FE3E3E7E3E060607878")
320 CALL CHAR(112,"FFFF"):: CALL C
    HAR(113,"C0C0C0C0C0C0C0C"):: C
    ALL CHAR(114,"FFFFC0C0C0C0C0C0
    ")
330 CALL CHAR(115,"03070E1C3870E0C
    ")
340 CALL CHAR(116,"C0E070381C0E070
    3"):: CALL CHAR(120,"")
350 CALL CHAR(128,"000001010101030
    50901020408040000000080C08080C
    0A09080402810000000")
360 CALL CHAR(132,"07050704077FFFC
    767776707060C7878E0A0E020E0FEF
    FE3E6EEE6E060301E1E"):: CALL C
    HAR(136,"")
370 REM "WANT INSTRUCTIONS?"
380 CALL COLSCHEME(16,14):: DISPLA
    Y AT(12,3):"DO YOU WANT INSTRU
    CTIONS": :"      (YES OR NO)?"
390 CALL KEYYN(K):: IF K=78 THEN M
    $="NO" ELSE M$="YES"
400 DISPLAY AT(14,20):M$ :: CALL D
    ELAY(150):: IF K=78 THEN 480 E
    LSE K=48
410 REM INSTRUCTIONS
420 CALL COLSCHEME(2,12):: DISPLAY
     AT(1,7):"HERE IS THE BOARD":"
       AND HOW IT IS NUMBERED@"
430 H=1 :: GOSUB 2090 :: CALL PAUS
    E(K):: GOSUB 2250
440 CALL COLSCHEME(2,12):: DISPLAY
     AT(8,1):"BY THE WAY, DURING T
    HE GAME": :"YOU ALSO HAVE THES
    E OPTIONS:     "
450 DISPLAY AT(13,2):"PRESS ""0""
    TO REVIEW RULES": :"
       OR": :" PRESS ""9"" TO CHAN
    GE GAME."
460 CALL PAUSE(K):: IF K=48 THEN 4
    20
470 REM "CHOICE?"
480 CALL DELSPRITE(ALL):: CALL COL
    SCHEME(2,15)
490 DISPLAY AT(2,1):"HERE ARE THE
    POSSIBLE WAYS  TO PLAY:"
500 DISPLAY AT(6,1):"1. YOU ARE TH
    E GIANT, AND I       AM THE DWA
    RFS"
510 DISPLAY AT(9,1):"2. I AM THE G
    IANT, AND YOU        ARE THE DW
    ARFS"
520 DISPLAY AT(12,1):"3. YOU AND A
     FRIEND PLAY          GIANT AND
     DWARFS"
530 DISPLAY AT(15,1):"4. I PLAY GI
    ANT AND DWARFS         BY MYSELF
     (AFTER YOU"
540 DISPLAY AT(17,6):"HAVE TRIED 1
    . AND 2. AT":"      LEAST FOUR
    TIMES EACH)"
550 DISPLAY AT(20,1):"(OR PRESS ""
    0"" TO REVIEW THE RULES.)" ::
    DISPLAY AT(23,1):"WHAT IS YOUR
     CHOICE?"
560 CALL KEY(0,K,S):: IF K<48 OR K
    >53 THEN 560
570 H=K-48 :: M$=CHR$(K):: IF K=53
     THEN M$="4"
580 DISPLAY AT(23,22):M$ :: CALL D
    ELAY(75):: ON H+1 GOTO 420,650
    ,650,650,590,630
590 IF H1>3 AND H2>3 THEN 640
600 CALL COLSCHEME(2,11):: CALL SO
    UND(4250,-4,0)
610 DISPLAY AT(12,3):"NOT ALLOWED!
    --YOU HAVEN'T": :" TRIED 1. AN
    D 2. ENOUGH YET!"
620 CALL SOUND(1,-4,0):: GOTO 480
630 H=4
640 REM PLAY GAME!
650 N=1 :: GOSUB 2080
660 CALL DELSPRITE(ALL):: P=111000
    00 :: M1,M2,M3,P1,P2=0
670 FOR I=1 TO 3 :: Z(I)=I :: NEXT
     I :: FOR I=4 TO 8 :: Z(I)=0 :
    : NEXT I
680 CALL MAGNIFY(4):: FOR I=1 TO 3
     :: CALL SPRITE(#I,96,2,SR(I),
    SC(I)):: NEXT I
690 DISPLAY AT(22,1):"": :"" :: IF
     P=1112 THEN 1730
700 DISPLAY AT(22,12):"GIANT" :: P
    L=2 :: M1=M3 :: ON H GOTO 1960
    ,1170,1960,1170
710 GOTO 1130
720 DISPLAY AT(22,1):"": :"" :: IF
     P1>3 OR P2>3 THEN GW=1 :: GOT
    O 1760
730 IF M3<5 THEN GW=2 :: GOTO 1760
740 DISPLAY AT(22,12):"DWARFS" ::
    PL=1 :: ON H GOTO 1380,1970,19
    70,1380
750 REM MOVE PIECE
760 IF PL=2 THEN Z(M1)=4
770 RD=R(M2)-R(M1):: CD=C(M2)-C(M1
    )
780 FOR I=PL TO 8 STEP PL :: CALL
    LOCATE(#Z(M1),SR(M1)+RD*I,SC(M
    1)+CD*I)
790 CALL PATTERN(#Z(M1),124+4*PL):
    : CALL SOUND(1,880/PL^2,16/PL^
    4)
800 CALL LOCATE(#Z(M1),SR(M1)+RD*I
    ,SC(M1)+CD*I)
810 CALL PATTERN(#Z(M1),92+4*PL)::
     CALL SOUND(1,440/PL^2,16/PL^4
    )
820 NEXT I
830 Z(M2)=Z(M1):: Z(M1)=0 :: IF PL
    =2 THEN M3=M2 :: Z(M3)=4
840 IF Z(8)<>0 AND Z(8)<>4 THEN GW
    =2 :: GOTO 1760
850 IF PL=2 AND P=111020 THEN P1=P
    1+1
860 IF PL=2 AND P=1012010 THEN P2=
    P2+1
870 IF PL=1 THEN 690 ELSE 720
880 REM ACCEPT/DISPLAY MOVE
```

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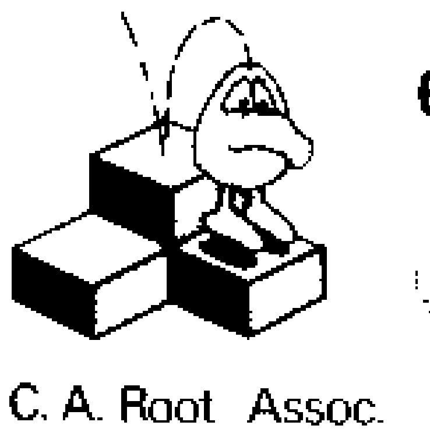

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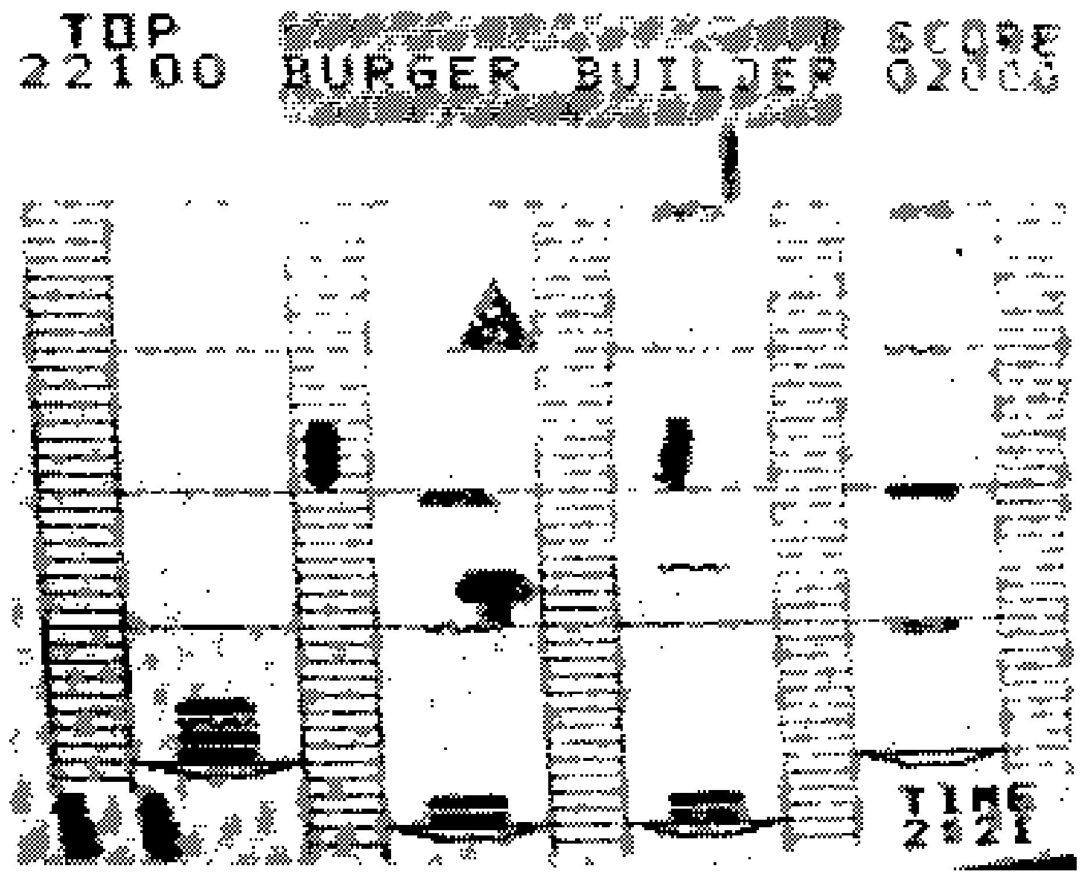

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GIANT & DWARFS

```
890 CALL KEY(0,K,S):: IF K<48 OR K
>57 THEN 890
900 M=K-48 :: M$=CHR$(K):: DISPLAY
 AT(23,CO-2)SIZE(1):M$ :: IF M
$="9" THEN 480
910 IF M$="0" THEN CALL COLOR(#1,1
,#2,1,#3,1,#4,1):: GOSUB 2260
:: GOSUB 2080 :: ON PL GOTO 74
0,700
920 IF CO=17 THEN 1980 ELSE 940
930 REM CHECK FOR ILLEGAL MOVE
940 M2=M :: IF Z(M2)=0 THEN 970
950 ON PL GOTO 720,690
960 ON PL GOSUB 1970,1960
970 IF M1=0 THEN 1090
980 ON M1 GOTO 990,1000,1010,1020,
1030,1040,1050,1060
990 IF M2<2 OR M2>4 THEN 1080 ELSE
 1110
1000 ON M2 GOTO 1070,1080,1110,1110
,1110,1080,1080,1080
1010 ON M2 GOTO 1070,1110,1110,1110
,1080,1080,1110,1080
1020 ON M2 GOTO 1070,1070,1070,1080
,1110,1110,1110,1080
1030 ON M2 GOTO 1080,1070,1080,1070
,1080,1110,1080,1110
1040 ON M2 GOTO 1080,1080,1080,1070
,1110,1080,1110,1110
1050 ON M2 GOTO 1080,1080,1070,1070
,1080,1110,1080,1110
1060 ON M2 GOTO 1080,1080,1080,1080
,1070,1070,1070,1080
1070 IF PL=2 THEN 1110
1080 GOTO 950
1090 IF M2<5 THEN 950
1100 IF P=11100000 AND(H=1 OR H=3)T
HEN ON M2-4 GOTO 1670,1680,169
0,1700
1110 IF PL=1 THEN 1130 ELSE 710
1120 REM UPDATE POSITION
1130 P=P-PL*10^(8-M1)+PL*10^(8-M2):
: IF PL=2 THEN M3=M2
1140 IF H=4 THEN CALL KEY(0,K,S)::
IF K=57 THEN 480
1150 GOTO 760
1160 REM COMPUTER'S MOVE FOR GIANT
1170 IF P=11100000 THEN IF H=2 OR H
=4 THEN 1660
1180 IF Z(2)=0 AND M1=5 THEN M2=2
1190 IF Z(3)=0 AND M1=7 THEN M2=3
1200 IF Z(4)=0 AND(M1=5 OR M1=6 OR
M1=7)THEN M2=4
1210 IF P=1010210 OR P=1010012 THEN
 M2=5
1220 IF P=11010200 OR P=11010002 OR
 P=100112 OR P=110102 OR P=100
0112 OR P=10100012 THEN M2=5
1230 IF P=10000112 OR P=10100102 OR
 P=10112 THEN M2=5
1240 IF P=11012 OR P=110012 THEN M2
=6
1250 IF P=1011002 OR P=1112000 OR P
=1110020 OR P=1110002 OR P=110
0012 OR P=1101002 THEN M2=6
1260 IF P=10010012 OR P=10011002 OR
 P=101012 OR P=1001012 OR P=10
101002 OR P=11000012 OR P=1000
1012 THEN M2=6
1270 IF P=111200 OR P=111002 THEN M
2=7
1280 IF P=10110200 OR P=10110002 OR
 P=1001102 OR P=1010102 OR P=1
01102 OR P=11001002 THEN M2=7
1290 IF P=10001102 OR P=11000102 OR
 P=11102 THEN M2=7
1300 IF P=11210 OR P=1012010 OR P=1
11020 OR P=1011200 OR P=110210
 OR P=1011200 OR P=1110200 THE
N M2=8
1310 IF P=10110020 OR P=11012000 OR
 P=110120 OR P=1012100 OR P=10
011200 OR P=10010210 THEN M2=8
1320 IF P=10021010 THEN IF RN(2)=1
THEN M2=2 ELSE M2=3
1330 IF P=1100102 THEN IF RN(2)=1 T
HEN M2=5 ELSE M2=7
1340 IF P=110210 THEN IF RN(2)=1 TH
EN M2=5 ELSE M2=8
1350 IF P=1011200 THEN IF RN(2)=1 T
HEN M2=7 ELSE M2=8
1360 GOTO 710
1370 REM COMPUTER'S MOVE FOR DWARFS
1380 IF P=10012010 OR P=10011200 OR
 P=10101002 OR P=10100012 OR P
=10110200 THEN M4=12
1390 IF P=10011020 OR P=10010210 OR
 P=11000012 OR P=11001002 OR P
=11010200 THEN M4=13
1400 IF P=11002010 OR P=10101020 OR
 P=11001200 OR P=10100210 OR P
=11100200 OR P=10001210 THEN M
4=14
1410 IF P=1011020 OR P=11001002 OR
P=11010020 OR P=1011200 THEN M
4=23
1420 IF P=1101020 OR P=1100210 THEN
 M4=24
1430 IF P=11001200 OR P=11000210 OR
 P=11001002 OR P=11000012 OR P
=11100020 OR P=1001210 THEN M4
=24
1440 IF P=1110020 OR P=1010210 THEN
 M4=25
1450 IF P=112010 OR P=10100012 OR P
=10112000 OR P=110210 THEN M4=
32
1460 IF P=1102010 OR P=1101200 THEN
 M4=34
1470 IF P=10100210 OR P=10101200 OR
 P=10100012 OR P=10101002 OR P
=11102000 OR P=101210 THEN M4=
34
```

Continued on p. 58

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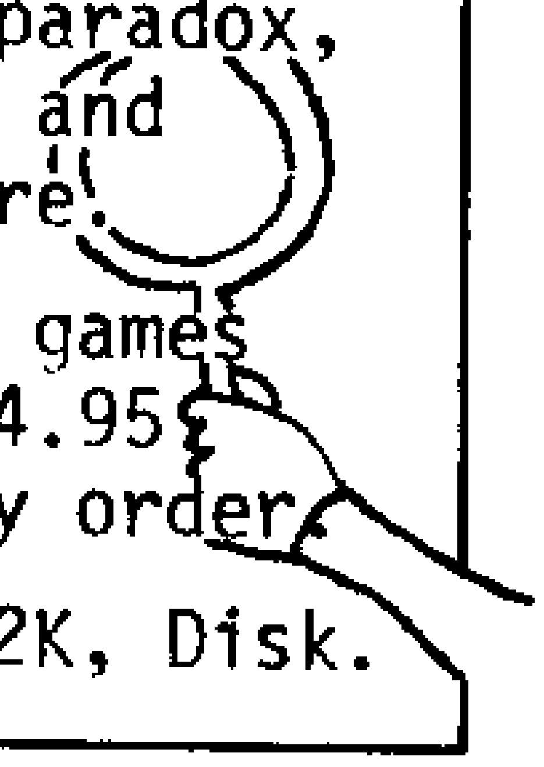

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GIANT & DWARFS . . . from p. 57

```
1480 IF P=1112000 OR P=111200 THEN
     M4=37
1490 IF P=110012 OR P=1010012 OR P=
     10010012 THEN M4=45
1500 IF P=11012 THEN M4=46
1510 IF P=1011002 OR P=111002 OR P=
     10011002 THEN M4=47
1520 IF P=111020 THEN M4=56
1530 IF P=110120 OR P=10100102 THEN
      M4=65
1540 IF P=1012100 OR P=11000102 THE
     N M4=67
1550 IF P=1012010 THEN M4=76
1560 IF P=11010200 THEN IF RN(3)=1
     THEN M4=25 ELSE M4=13
1570 IF P=1110200 OR P=11100002 THE
     N IF RN(2)=1 THEN M4=25 ELSE M
     4=37
1580 IF P=11010002 THEN IF RN(2)=1
     THEN M4=25 ELSE M4=47
1590 IF P=10110200 THEN IF RN(3)=1
     THEN M4=37 ELSE M4=12
1600 IF P=10110002 THEN IF RN(2)=1
     THEN M4=37 ELSE M4=45
1610 IF P=1110002 THEN IF RN(2)=1 T
     HEN M4=45 ELSE M4=47
1620 IF P=1100102 OR P=1010102 OR P
     =110102 THEN IF RN(2)=1 THEN M
     4=65 ELSE M4=67
1630 IF (P=11100002 OR P=11100020 O
     R P=11102000)AND H=4 THEN IF R
     N(2)=1 THEN M4=14
1640 M1=INT(M4/10):: M2=M4-M1*10 ::
      GOTO 1130
1650 REM COMPUTER'S 1ST MOVE FOR GI
     ANT
1660 ON RN(9)GOTO 1670,1670,1670,16
     80,1690,1690,1690,1700,1700
1670 I=5 :: GOTO 1710
1680 I=6 :: GOTO 1710
1690 I=7 :: GOTO 1710
1700 I=8
1710 P=11100000+2*10^(8-I):: Z(I)=4
      :: CALL SPRITE(#4,100,2,SR(I)
     ,SC(I)):: M1,M2,M3=I :: GOTO 7
     10
1720 REM GAME ENDED
1730 DISPLAY AT(22,7):"THE DWARFS W
     IN!" :: IF H=1 THEN CW=CW+1
1740 IF H=2 THEN HW=HW+1
1750 GOTO 1800
1760 DISPLAY AT(22,7):"THE GIANT WI
     NS!)"
1770 IF GW=1 THEN DISPLAY AT(23,9):
     "(STALEMATE)" ELSE DISPLAY AT(
     23,7):"(BREAK-THROUGH)"
1780 IF PL=1 THEN DISPLAY AT(24,3):
     "(DWARF ON 8 CAN'T MOVE)"
1790 IF H=2 THEN CW=CW+1
1800 GOSUB 2020 :: CALL DELAY(500):
     : IF H=1 THEN H1=H1+1
1810 IF H=2 THEN H2=H2+1
1820 IF H<3 THEN DISPLAY AT(22,7):"
         SCORE@":"           COMPUTER
     @":"" :: DISPLAY AT(23,18):USI
     NG "###":CW
1830 IF H<3 THEN DISPLAY AT(24,9):"
     HUMANS@   " :: DISPLAY AT(24,18
     ):USING "###":HW :: CALL DELAY
     (600)
1840 DISPLAY AT(22,1):"ANOTHER GAME
      (YES OR NO)^":"":""
1850 CALL KEYYN(K)
1860 IF K=78 THEN 1910 ELSE DISPLAY
      AT(22,26):"YES" :: CALL DELAY
     (100)
1870 DISPLAY AT(24,2):"SAME KIND (Y
     ES OR NO)^"
1880 CALL KEYYN(K)
1890 IF K=78 THEN DISPLAY AT(24,25)
     :"NO" :: CALL DELAY(100):: GOT
     O 480
1900 DISPLAY AT(24,25):"YES" :: CAL
     L DELSPRITE(ALL):: CALL DELAY(
     100):: GOTO 660
1910 DISPLAY AT(22,27):"NO" :: CALL
      DELAY(100)
1920 CALL DELSPRITE(ALL):: CALL COL
     SCHEME(16,14):: DISPLAY AT(12,
     4):"THANK YOU FOR PLAYING."
1930 H=0 :: GOSUB 2010 :: CALL CLEA
     R
1940 STOP
1950 REM "FROM?/TO?"
1960 DISPLAY AT(23,12):"TO^" :: CO=
     18 :: GOTO 890
1970 DISPLAY AT(23,10):"FROM^" :: C
     O=17 :: GOTO 890
1980 M1=M :: IF Z(M1)=0 OR Z(M1)=4
     THEN 1970
1990 DISPLAY AT(23,17):"TO^" :: CO=
     22 :: GOTO 890
2000 REM MUSICAL THEMES
2010 FOR PL=2 TO 1 STEP -1
2020 FOR I=1 TO 10 :: CALL SOUND(20
     ,4*T(I)/(PL^2),16/PL^3):: NEXT
      I
2030 FOR I=1 TO 4 :: CALL SOUND(40,
     (880/PL^3),16/PL^3):: NEXT I
2040 IF H<>0 THEN 2060
2050 NEXT PL
2060 RETURN
2070 REM DISPLAY BOARD
2080 CALL COLSCHEME(2,C2(H)):: IF M
     $="0" THEN CALL COLOR(#1,2,#2,
     2,#3,2,#4,2)
2090 CALL COLOR(9,2,1):: CALL COLOR
     (10,16,C1(H))
2100 CALL COLOR(11,16,C1(H)):: CALL
      COLOR(12,2,16):: CALL COLOR(1
     3,2,C1(H)):: CALL COLOR(14,C1(
     H),C1(H))
2110 CALL HCHAR(4,1,136,576)
```

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GIANT & DWARFS

```
2120 CALL HCHAR(7,13,112,8):: CALL
     HCHAR(13,7,112,20):: CALL HCHA
     R(19,13,112,8)
2130 CALL VCHAR(9,11,113,8):: CALL
     HCHAR(13,11,114):: CALL VCHAR(
     9,23,113,8)
2140 IF K<>48 THEN DISPLAY AT(2,2):
     "G I A N T   &   D W A R F S"
2150 CALL HCHAR(10,7,115):: CALL HC
     HAR(9,8,115)
2160 FOR I=0 TO 7 :: CALL HCHAR(16-
     I,13+I,115):: NEXT I
2170 CALL HCHAR(16,25,115):: CALL H
     CHAR(15,26,115)
2180 CALL HCHAR(15,7,116):: CALL HC
     HAR(16,8,116)
2190 FOR I=0 TO 7 :: CALL VCHAR(9+I
     ,13+I,116):: NEXT I
2200 CALL HCHAR(9,25,116):: CALL HC
     HAR(10,26,116)
2210 FOR J=0 TO 3 :: FOR I=1 TO 8 :
     : CALL HCHAR(R(I)+J,C(I),120,4
     ):: NEXT I :: NEXT J
2220 FOR I=3 TO 4
2230 CALL COLOR(I,2,16):: NEXT I ::
      FOR I=1 TO 8 :: DISPLAY AT(R(
     I),C(I)-2)SIZE(1):STR$(I):: NE
     XT I
2240 RETURN
2250 REM RULES
2260 CALL COLSCHEME(16,5):: DISPLAY
      AT(1,1):"HERE ARE THE RULES I
     N BRIEF:"
2270 DISPLAY AT(3,4):"THE THREE DWA
     RFS OPEN":"   ON SQUARES 1, 2,
      AND 3."
2280 DISPLAY AT(6,4):"THE GIANT MAY
      OPEN ON":"   SQUARE 5, 6, 7,
     OR 8."
2290 DISPLAY AT(9,4):"THE DWARFS TR
     Y TO TRAP":"   THE GIANT ON SQ
     UARE 8."
2300 DISPLAY AT(12,4):"THE GIANT WI
     NS IF THE":"   DWARFS DON'T SU
     CCEED."
2310 DISPLAY AT(15,4):"THE DWARFS C
     AN MOVE ONE":"   SQUARE FORWAR
     DS OR":"   SIDEWAYS,NEVER BACK
     WARDS."
2320 DISPLAY AT(19,4):"THE GIANT CA
     N MOVE ONE":"   SQUARE IN ANY
     DIRECTION." :: CALL PAUSE(K)::
      CALL CLEAR
2330 DISPLAY AT(11,3):"NOTE THAT A
     'STALEMATE'": :"(THAT IS, THE
     SAME POSITION"
2340 DISPLAY AT(15,3):"OCCURRING RE
     PEATEDLY) IS": :"    A WIN FOR
      THE GIANT." :: CALL PAUSE(K)
2350 RETURN
2360 SUB DELAY(D)
2370 FOR I=1 TO D :: NEXT I
2380 SUBEND
2390 SUB PAUSE(K)
2400 DISPLAY AT(23,7):"PRESS SPACE
     BAR":"    WHEN READY TO GO ON.
     "
2410 CALL KEY(0,K,ST):: IF K<>32 AN
     D K<>48 THEN 2410
2420 SUBEND
2430 SUB COLSCHEME(F,B)
2440 CALL CLEAR :: CALL SCREEN(B)::
      FOR I=1 TO 8 :: CALL COLOR(I,
     F,B):: NEXT I
2450 SUBEND
2460 SUB KEYYN(K)
2470 CALL KEY(0,K,ST):: IF K<>78 AN
     D K<>89 THEN 2470
2480 SUBEND
```

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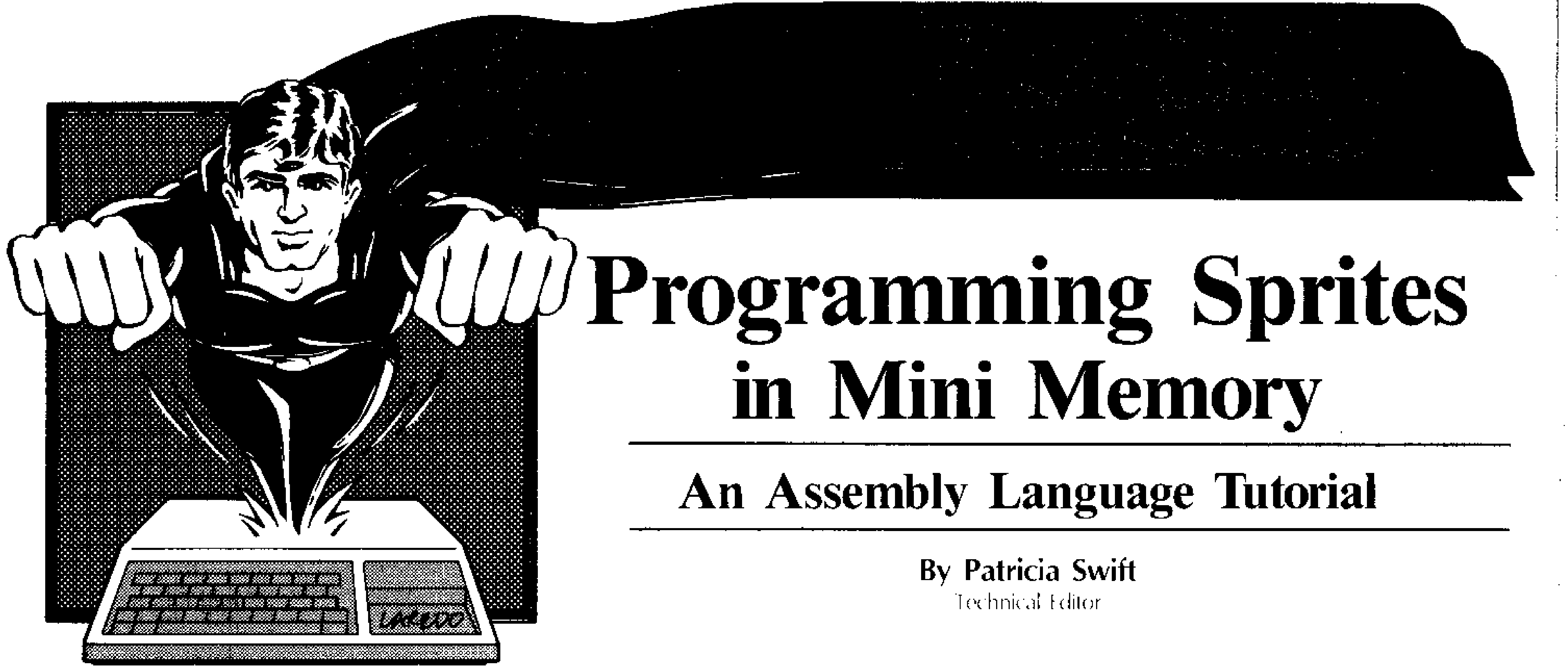


Programming Sprites in Mini Memory

An Assembly Language Tutorial

By Patricia Swift
Technical Editor

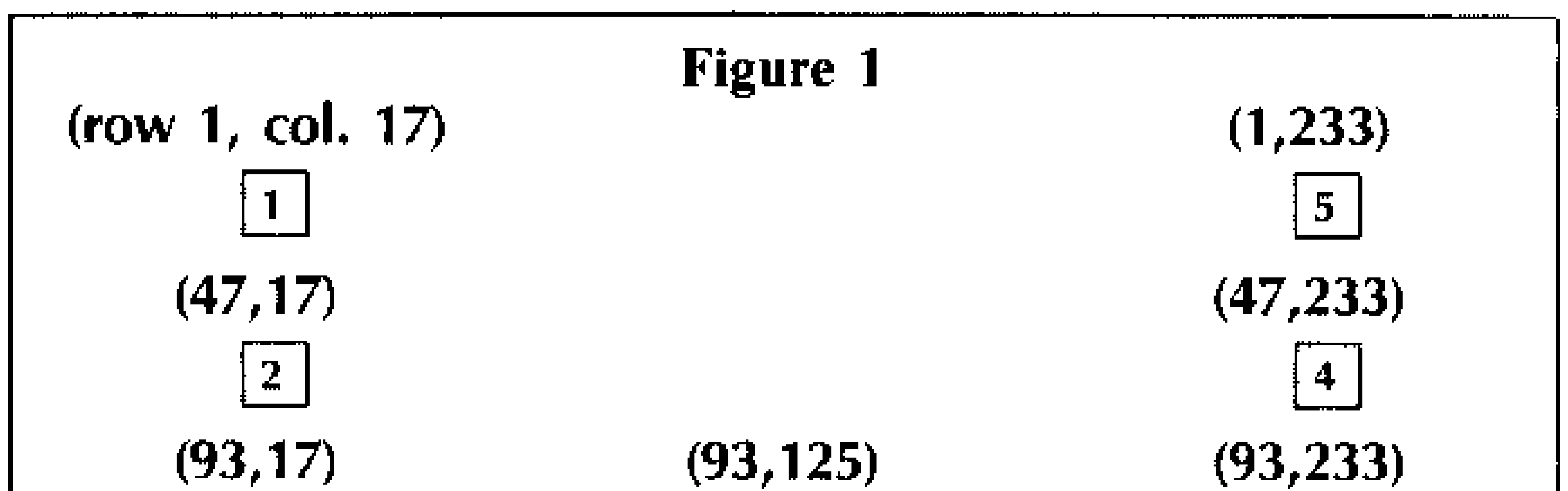
Sprites are among the most powerful features of the 99/4A computer. Using sprites in Assembly Language is not much more difficult than using them in Extended BASIC; it's mostly a matter of knowing where to locate the sprite tables and how to use them. This article explains how a simple program using sprites was designed and written for the Mini Memory Command Cartridge.

The Idea

I wanted to write a short program demonstrating three features of the 99/4A: 1) sprite movement, 2) the use of planes on the video screen, and 3) the speed of the processors. I decided that the program would start out with five different sprites at the left of the screen, that it would move each one to the center, then "peel them off" one by one and move them to the right. Since each sprite would be in a different plane, each would be hidden by the first sprite as it reached the center of the screen. During the peel-off process, sprite 2 would appear in the center as soon as sprite 1 was moved to the right, and so on. I didn't make any special plans to show the speed of the processor; I figured that would be self-evident. In fact, my experience has been that you often have to slow down the processing in order to work with it.

The first task in designing the program was to decide exactly where the sprites would appear on the screen and in which direction each would move. I already knew that the sprites would be spaced evenly in a column near the left of the screen, would travel on paths intersecting near the screen's center, and would end up close to the right of the screen after they were peeled off. Now I had to get specific about those screen locations. Figure 1 shows the diagram of the locations I decided to use. Note that in sprite mode, the screen contains 256 horizontal (X) columns and 192 vertical (Y) rows. Each of these 256 × 192 positions is called a pixel. From past experience I knew that the centering on most monitors and TV sets is off to one side or the other. This means that a few of the leftmost or rightmost pixels are often invisible. To allow for this, I decided not to use the first and last 16 columns of the screen.

Figure 1



The positions given in Figure 1 refer to the upper left corner of each sprite. The program will use regular size sprites of 8 × 8 pixels. You can see that the fifth sprite will start out in row 185; that is, it will occupy rows 185-192 and will just fit at the bottom of the screen without hanging over. Another point to notice: If you draw a straight line connecting the upper left corner of each sprite in its starting and ending positions, the line passes through the point (93,125). This is important because it lets us use the same directions to move a given sprite to the middle of the screen and later to the right side. In other words, the screen has been laid out to be perfectly symmetrical, which will make the program easier to write.

Next consider the shapes of the sprites. These are, of course, completely under your control. I have selected shapes at random here. You will probably want to substitute your own shapes. As for the colors of the sprites, the program looks best if you use five different colors, perhaps some different shades from the ones I used. The shapes and colors do not affect the logic of the program, only the appearance of the finished product.

Program Logic Overview

Now let's look at the logical steps needed to accomplish the task at hand. The program will do the following:

1. Set up some initial conditions, including the color of the screen and the shapes of the sprites.
2. Put the sprites at the left of the screen, but make them stationary for now.
3. Move sprite 1 to the center of the screen and stop it there. Then do the same for sprites 2 to 5.
4. Pause so that you can see the effect of all 5 sprites piled on top of one another.
5. Peel off sprite 1 by moving it to the right side of the screen. Do the same, in turn, for sprites 2 through 5. Pause again, and then go back to step 2 to perform the demonstration again. For simplicity, the program will continue to do the same thing forever (or until you hold down the QUIT key).

Writing the Program

First of all, the layout of the program itself needs some explanation. Most programs consist of program logic and data. The data may be placed anywhere in RAM, as long as the program logic knows where it is. I have chosen to put the data just before the program logic.

A word about the different types of RAM (Random Access Memory) in the 99/4A might also be helpful. There are CPU RAM and VDP RAM available for our use. CPU RAM Is the TMS9900's memory. When a person talks about memory, this is the memory usually referred to. Program logic and data usually reside in CPU RAM. VDP RAM belongs to the TMS9918(A), or video processor. VDP RAM is used in working with the screen, for such tasks as defining sprites and setting them in motion.

The next step is to actually code the Assembly Language program. The following discussion includes several facts about the structure of the 99/4A which are essential to understanding the program. To make it easier, I will break the discussion down into the five logical steps outlined above.

The code segments contain up to four fields on each line. The optional label is first, then the opcode, then operand(s), and finally some comments. When you enter the program via the Line-by-Line Assembler, do not try to enter the comments. (See my article on using the Line-by-Line Assembler in the January, 1983 issue of *99'er* for more details.)

Step 1.

Set up some initial conditions, including the color of the screen and the shapes of the sprites.

This portion of the program will be executed only once at the very beginning. Because the program will make use of workspace registers to hold some information, the first thing we must do is tell the system where these 16 registers start. The Mini Memory has a spot which can be used for this task, starting at address > 70B8 (note that > means a hexadecimal number). Therefore, the first statement of the program logic is in Part 4. This loads the number > 70B8 into the workspace pointer for the system's use later on.

For the highest possible contrast, I have decided to make the screen itself white. When the finished program is RUN from the Mini Memory, the system fills the screen with blank characters. Therefore, all we must do to get a white screen is set the color for a blank (character number 32) to white-on-white. The color table starts at address > 0380 in VDP RAM. Each color table entry is 1 byte long, and there is one entry for each 8 characters. The byte of VDP RAM at address > 0380 specifies the colors of character numbers 0 through 7, and so on. Because we're interested in character number 32, we want to set the color byte at > 0384 to mean white-on-white. Each color byte is divided into two *nybbles*: the first four bits give the foreground color, and the last four bits give the background color of the associated characters. The color code for white is > F. Therefore, we want to set the color bytes at > 0384 to > FF to get white-on-white.

Having decided the location of the color table entry to be changed and the color we want to change it to, we must now code the program segment to do it. You might think that all we have to do is move the byte > FF to location > 0384. This will not work because the Assembly Language "move" instructions operate only on CPU RAM. It is no problem to have the > FF in CPU RAM, but the color table is located in VDP RAM. We must use one of the built-in utilities to access VDP RAM. Because we want to move only one byte (>FF) from CPU RAM to VDP RAM, the right utility is VSBW (VDP Single Byte Write). The book which comes with the Mini Memory shows the entry point for VSBW as > 6024. We must tell VSBW what byte to write and where to write it by setting workspace register 0 to the VDP RAM address where the byte will be written (> 0384 in this case) and putting the value of the byte to be written (> FF) in the left half of workspace register 1. VSBW will ignore the right half of register 1, so it doesn't matter what we put there. The program segment to accomplish this is in Part 5.

The next step is to set up the shapes of the sprites. First we must define the shapes in the program, and then move these definitions to the Sprite Descriptor Table in VDP RAM. The easiest way to define the shapes in the program is by means of DATA statements. These statements allow us to put the desired shapes right into CPU RAM. Sprite shapes are constructed in much the same way as characters are defined in console BASIC with the CALL CHAR statement. It takes 8 bytes to define each sprite shape. Instead of using a string to define each shape (as you do in BASIC), we will use a series of

```
        AORG >7D00
*
* PART 1
*
SS      DATA >FF99,>99FF,>1824,>42C3  *
        DATA >8D9E,>834F,>B6AB,>7DC3  * SPRITE
        DATA >7D9F,>6ABE,>9ACD,>7DFE  *
        DATA >6DAC,>89AB,>98AE,>7FCD  * SHAPES
        DATA >9D7C,>89AB,>97CE,>88BA  *
*
* PART 2
*
SA      DATA >FF10,>8006   *
        DATA >2D10,>8103   * SPRITE ATTRIBUTE
        DATA >5B10,>8204   *
        DATA >8910,>830A   *        LIST
        DATA >B710,>840C   *
        DATA >D000         *
*
* PART 3
*
S1      DATA 0,0,0,0,0,0,0,0,0,0  * MOTION LIST
S2      DATA >2E36,>1736,>0036,>E936,>D236 ****
*
* PART 4
*
L1      LWPI >70B8       * SET UP WORK SPACE REG.
*
* PART 5  SET SCREEN COLOR
*
        LI   0,>0384    * SET REG. 0 TO >384
        LI   1,>FF00    * SET REG. 1 TO >FF00
        BLWP @>6024     * DO SINGLE BYTE WRITE
*
* PART 6
*
        LI   0,>0400    * SET REG. 0 TO >0400
        LI   1,SS       * GET ADDRESS OF SS
        LI   2,40       * WRITE 40 BYTES
        BLWP @>6028     * DO MULTIPLE BYTE WRITE
*
* PART 7
*
        LI   0,>0300    * ADD. OF ATTRIBUTE LIST
        LI   1,SA       * ADD. OF ATTRIBUTE DATA
        LI   2,21       * 21 BYTES TO WRITE
        BLWP @>6028     * DO MULTIPLE BYTE WRITE
*
* PART 8
*
        LI   0,>0780    * ADD. OF MOTION TABLE
        LI   1,S1       * ADD. OF MOTION DATA
        LI   2,20       * 20 BYTES TO WRITE
        BLWP @>6028     * DO MULTIPLE BYTE WRITE
*
```

```
* PART 9
*
        LI   1,>0500    * LEFT BYTE = # OF SPRITES
        MOVB 1,@>837A   * SAVE # OF MOVING SPRITES
*
* PART 10
*
        LI   8,124      * LOAD X COORDINATE FOR TEST
L2      LI   6,S2       * POINTS TO MOTION DATA
        LI   4,>0780    * POINTS TO MOTION TABLE
        LI   5,>0301    * ADD. OF SPRITES X COORD.
L3      MOV  4,0        * GET MOTION TABLE ADD.
        MOV  6,1        * GET MOTION DATA ADD.
        LI   2,2        * TWO BYTES TO MOVE
        BLWP @>6028     * VMBW
L4      LIMI 2          * ENABLE INTERUPTS
        LIMI 0          * DISABLE INTERUPTS
        MOV  5,0        * POINT TO X COORDINATE
        BLWP @>602C     * SINGLE BYTE READ
        SRL  1,8        * SHIFT X COORDINATE
        C    1,8        * IS SPRITE AT THE LIMIT?
        JLT  L4         * NO. KEEP MOVING SPRITE
        MOV  4,0        * POINT TO MOTION TABLE
        LI   1,S1       * GET ZERO VELOCITIES
        LI   2,2        * TWO BYTES TO MOVE
        BLWP @>6028     * VMBW
        INCT 6          * INCREMENT REG. 6 BY 2
        INCT 4          * INCREMENT REG. 4
        INCT 4          *     "       "   "
        INCT 5          * INCREMENT REG. 5
        INCT 5          *     "       "   "
        CI   4,>0794    * ALL DONE YET?
        JLT  L3         * NO. DO NEXT SPRITE
*
* PART 11
*
        LI   9,32767    *
        DEC  9          * TIME DELAY
        JNE  $-2        *
*
* PART 12
*
        CI   8,125      * ARE WE ON SECOND PASS
        JGT  L1         * YES. START OVER
        LI   8,232      * X COORDINATE OF RIGHT EDGE
        JMP  L2         * START PEEL OFF
*
* PART 13            SHOULD BE 7FE8
*
        AORG >7FF8 ←    * GETS YOU INTO DEF TABLE
        TEXT 'SPRITE'   * DEFINES PROGRAM NAME
        DATA >7D5C      * START OF PROGRAM
        AORG >701E      * GETS INTO TABLE POINTER
        DATA >7FF8      * DEF TABLE POINTER ADD.
        END
```

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16 hexadecimal digits grouped 4 at a time. This is because the DATA statement assigns values to words (two-byte chunks of memory). I have used the label SS to refer to the beginning of the first DATA statement containing sprite shapes. Remember, all data statements will be put before the start of the program logic (see Part 1).

Now that the shapes have been defined in the program, we must move them to the Sprite Descriptor Table in VDP RAM. But first we must consider exactly where in this table to put them. Just as the CALL CHAR statement in console BASIC assigns a character number to the shape description, we must decide what numbers will be associated with each of our sprites. In theory, we may choose any character number between 0 and 255, but in practice it is best to choose character numbers of 128 and higher for sprites. The Sprite Descriptor Table starts at address >0400 in VDP RAM and each entry in the table occupies 8 bytes. We must use character numbers (for the pattern codes) starting at 128 (>80) for sprites. We will use character numbers 128 though 132 for our five sprites. To calculate where to put a pattern definition in the Sprite Descriptor Table, just multiply the sprite's character number by 8. Thus, the pattern of the first of the sprites should be loaded into VDP RAM address 128 × 8 = 1024 (or >0400). Because our five sprites have adjacent character numbers, their patterns will reside in adjacent portions of the Sprite Descriptor Table. To move the patterns of the sprites from our program to VDP RAM, we will use another built-in utility called VMBW (VDP Multiple Byte Write). This utility expects the VDP RAM address where the data will be written (> 0400 in our case) to be in workspace register 0, the address in CPU RAM where the data resides (label SS here) in register 1, and the number of bytes to be moved (8 bytes for each of 5 sprites, or 40) in register 2. The code segment for moving the sprite shapes into the Sprite Descriptor Table is in Part 6.

Step 2

Put the sprites at the left of the screen, but make them stationary for now.

The positions of the sprites are defined in still another table called the Sprite Attribute List. The Sprite Attribute List starts at VDP RAM address >0300, and has room for 32 four-byte entries, one for each of the 32 possible sprites. Each four-byte entry consists of the Y-position of the upper left corner of the sprite, the X-position of the upper left corner, the pattern code (or character number, as I have been calling it), and the color of the sprite.

The definition of the Y-coordinate of the sprite is not completely straightforward. If we want the sprite to start out at the very top of the screen (row 1), then we must specify the Y-coordinate as >FF. For row 2, the Y-coordinate must be given as >00. Thereafter the Y-positions proceed in order through > BE (or 190 in decimal), for a total of 192 possible rows. With higher row numbers, the sprites are off the bottom of the screen.

The definition of the X-coordinate is more straightforward. The X-coordinates may assume values of > 00 (for the leftmost column) through >FF (for the rightmost column). We would probably call the leftmost column number 1 and the rightmost column number 256, but the computer thinks of them as columns 0 through 255.

The pattern code byte gives just the number of the pattern associated with the sprite. We will use pattern codes >80 through >84 because we have placed the sprite patterns in the Sprite Descriptor Table locations belonging to these patterns.

The fourth byte contains the *early clock* attribute in the first nybble and the sprite color in the second nybble. For simplicity, we will use an early clock attribute of 0 for all our sprites and not go into the reasons. Color numbers are specified as values between >0 and >F (decimal 15). To calculate the color number to use here, just subtract 1 from the color number used in BASIC's CALL COLOR statement.

If a program is not using all 32 sprites, then the programmer should disable all unused sprites by placing the value >D0 in the Y-coordinate of the first unused sprite. This allows the processor to operate more efficiently on the active sprites.

Now to apply this information to the task at hand. We must load 21 bytes into the Sprite Attribute List, four bytes for each of five sprites plus the byte >D0 to disable the rest of the sprites. The first sprite will have its upper left corner at row 1, column 17. This means that the first two bytes of its Sprite Attribute List entry should be >FF and >10. The pattern code for the first sprite is >80 (128). To make it dark red, we'll use the color number 6 in the second half of the fourth byte of its Sprite Attribute List entry. (Remember that the first half of the fourth byte will always be 0 in this program). Putting these four bytes together into groups of two bytes, we would use >FF10 and >8006 for the first two words of the Sprite Attribute List. In code segment part 7, we again use the utility VMBW to move the data defined by us in CPU RAM to the Sprite Attribute List in VDP RAM. First define the necessary data in CPU RAM, remembering that these statements are placed above the program logic (see code segment Part 2). Then move this data from CPU RAM to VDP RAM starting at address >0300.

Now we come to a most intriguing feature of sprites: their velocity. We want to start all the sprites off as stationary, and make provision for the computer to move the sprites in the right directions when the time comes. To do this, we must understand how the Sprite Motion Table works.

The Sprite Motion Table starts at VDP RAM address >0780, with room for a four-byte entry for each of the 32 possible sprites. Because we are using only five sprites, we need only fill the first 20 bytes of this table.

Each four-byte entry must contain the vertical (Y) speed of the sprite in the first byte and the horizontal (X) velocity of the sprite in the second byte. The third and fourth bytes are used by the system, so we don't need to set them. By defining an X and Y velocity for each sprite, we effectively define the speed and direction of the sprites (as the resultant vector). The velocities we put in the Sprite Motion Table must be between >00 and >FF. The computer will interpret velocities between >00 and >7F as positive, meaning down for Y or to the right for X. Velocities between >80 and >FF will be interpreted as negative (*two's complement*) speeds, meaning up for Y or to the left for X. You might be wondering in what units these velocities are expressed. A velocity of >01 causes the sprite to move one pixel every 16/60 of a second.

At first, we'll want all our sprite velocities to be 0 so that the sprites will not move. Then we'll want to set the velocities for each sprite to some value in order to set the sprite in motion. Let's consider what these velocities will be so that we can set them up now. The first sprite starts at row 1, column 17 and must eventually arrive at the center of the screen which we have designated as row 93, column 125. This means that the first sprite must move 92 units down for each 108 units it moves to the right. In my first version of the program, I set the Y-velocity to 92 and the X-velocity to 108 for the first sprite. Unfortunately, this made the sprites move too fast for the eye to follow. Therefore I decided to halve these velocities. This had the effect of moving the sprites more slowly while preserving the direction of the motion. For the first sprite, we'll use a Y-velocity of 46 (>2E) and an X-velocity of 54 (>36).

When we are ready to have the computer move the first sprite, we will move the value >2E36 to the first two bytes of the Sprite Motion Table. Notice that this same value will be used later on to move the first sprite from the center to the lower right hand corner of the screen, and that the final position of the first sprite will be row 185, colum 233 (refer to Figure 1). The fourth sprite will start at row 139, column 17 and move to the center at row 93, column 125. This sprite will have to move up 46 units while moving 108 units to the right. Dividing these by 2, we get a Y-vector of 23 and an X-vector of 54, or >E9 in Y and >35 in X. (Note that >E9 is −23 in two's complement form.)

Now we're ready to define data areas for the initial values and the later values of the Sprite Motion Table. To start out, we'll need to fill the first 20 bytes of the table. After that, we'll only move the two velocity bytes for each sprite into the right spot in the Sprite Motion Table, so we'll have to define only 10 bytes of velocities (2 for each sprite) to be used later (see Part 3).

At this point, we can move the initial values into the beginning of the Sprite Motion Table. Once again we'll use the utility VMBW to transfer the 20 bytes starting at label S1 to VDP RAM starting at address >0780 (see Part 8).

The last thing to set up before we get to the meat of the program is to tell the computer how many sprites must be moved (5 in our case). This is done by placing the number of sprites at CPU RAM address >837A (see Part 9).

Step 3

Move sprite 1 to the center of the screen and stop it there. Then do the same for sprites 2 to 5.

With 5 sprites arranged at the left edge of the screen, it's time to start moving them one by one. The basic logic for moving each sprite is as follows: set the sprite in motion by moving one of the velocities already set up at label S2 into the correct spot in the Sprite Motion Table, then repeatedly test the current X-coordinate of the

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sprites. Freeze the motion of the sprite when its X-coordinate first exceeds 123. Remember that although we have been thinking of the center of the screen as X-position 125, the computer calls that spot X-coordinate 124.

There are more facts you must know if you want the computer to move the sprites automatically. The computer will move sprites only when the VDP interrupt is enabled. However, you must disable the VDP interrupt whenever your program reads or writes to VDP RAM. When the program is first RUN, the VDP interrupt is disabled by default. That is why we didn't have to do anything about this interrupt when we were loading the sprite tables in the previous section. But we must enable the VDP interrupt when we are ready to move a sprite, and disable it when we want to check the X-position of the sprite to see if it has reached the center of the screen.

Now you can see that the logic for moving the sprites will have to be as follows:

A. Get the sprite ready to move by putting the correct velocity from S2 to the correct spot in the Sprite Motion Table. Leave the velocities of all the other sprites set to 0 so they won't move.
B. Enable the VDP interrupt so that the computer can move the sprite.
C. Disable the VDP interrupt.
D. Get the byte which represents the sprite's X-position from the correct spot in the Sprite Attribute List in VDP RAM.
E. Examine this byte. If it is less than 124, the sprite has not reached the center of the screen yet, so go back to step B and continue moving the sprite.
F. Otherwise it's time to freeze that sprite. To do this, just change its velocities to 0 in the Sprite Motion Table.
G. After each sprite has been frozen, see if there is another sprite to be moved. If there is, go back to step A.

There are three things which vary in this logic according to which sprite is being moved, and they are all addresses. This first variable is the location of the sprite velocities to be used. We set up two bytes for each sprite starting at label S2. We'll want the system to use the two bytes at S2 for the first sprite, the two bytes at S2+2 for the second sprite, and so on. The second variable is the address of the sprite's entry in the Sprite Motion Table. This starts at >0780 for the first sprite, >0784 for the second, and so on. The third variable is the location of the sprite's X-coordinate byte in the Sprite Attribute List. This is at >0301 for the first sprite (the list actually starts at >0300, but the X-coordinate is the second byte of each entry), at >0305 for the second sprite, and so on. We will use workspace registers to hold these variables. Just before step A, we will load 3 registers, (4, 5, and 6) with the addresses for the first sprite. Then, as part of step F, we will increment each register so that it contains the appropriate address for the next sprite.

We should add one more variable to this section of processing. So far, we have been discussing the first movement (from the left edge to the center of the screen) for each sprite. As I mentioned before, the second movements (from the center to the right edge) will be very similiar. In fact, there is only one difference: The X-coordinate of the sprite at its destination. At the center of the screen, the X-coordinate will be 124; at the right side, it will be 232. We will be able to reuse the logic for moving the sprites if we introduce one more variable now: the X-coordinate to be tested in step E. We will keep this value in register 8.

To obtain the sprite's current X-coordinate, we will use another utility routine called VSBR (VDP Single Byte Read). We must put the VDP RAM address to be read in register 0, and VSBR returns the contents of the byte at that address in the leftmost half of register 1. The code for this section of logic is in Part 10.

The second-to-last line might need some explanation. We started register 4 out at >0780 for the first sprite, and added 4 to it each time we completed moving a sprite. Therefore, after five passes, register 4 will be up to >0794. This will be the signal for the system to quit moving sprites for now.

Step 4

Pause so that you can see the effect of all five sprites piled on top of one another.

This part is easy. All we have to do is put in a small loop to delay the action for a while. This I generally do by loading a value into a workspace register, and then decrementing the register by 1 until it contains 0.

Continued on p. 69

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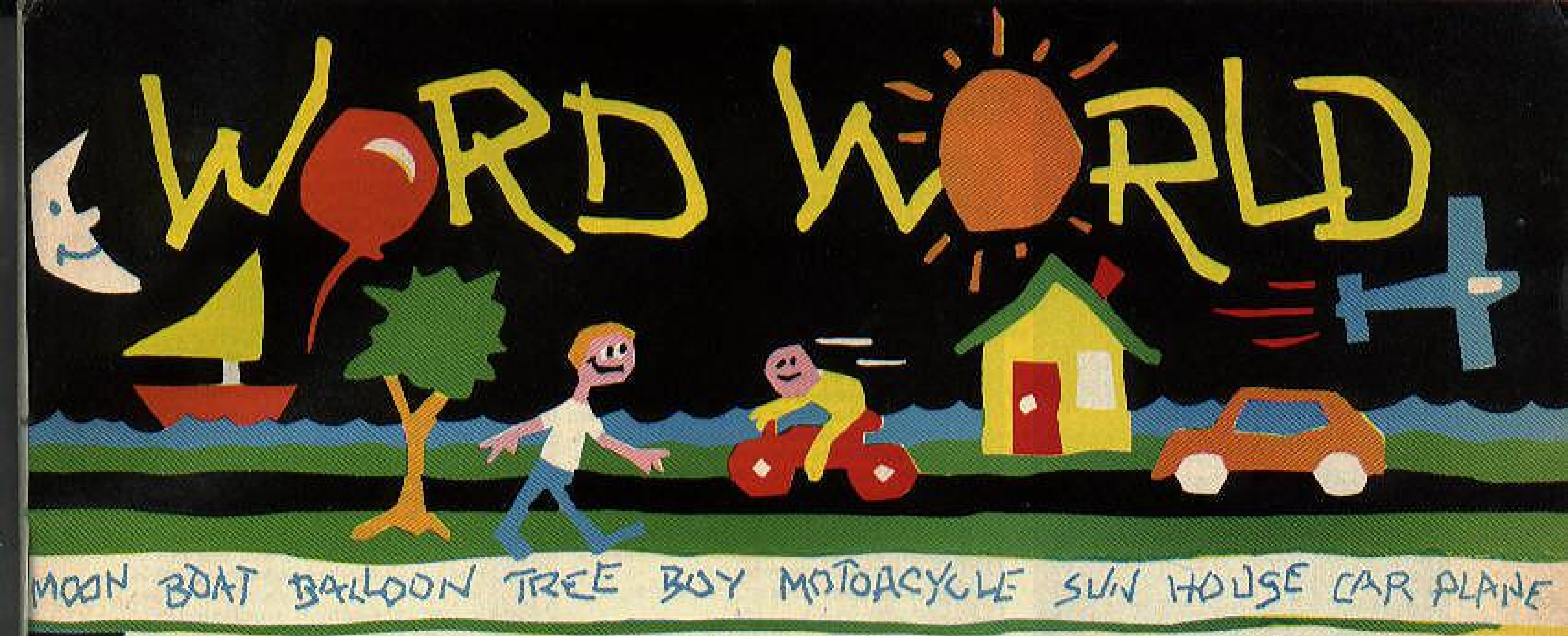
WORD WORLD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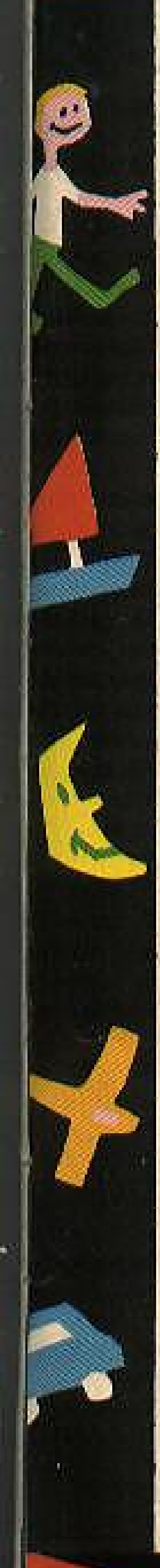


By Anthony N. Falco

141 Hudson Street Northboro, MA 01532

I had owned my TI-99/4A Computer about three months when I became fascinated with the LOGO language and with the concept of a "microworld" as a learning experience. It occurred to me that I might be able to develop an Extended BASIC program utilizing sound, color, and sprites to help my three-year-old son develop reading readiness skills. He had already pretty much mastered the alphabet and numbers 1-9 via some programs that I had written for him.

Only two weeks earlier, I had purchased a TI Extended BASIC cartridge and I was eager to learn how to use the sprite subroutines. The next weekend my daughters helped me design the shapes of objects which were to become sprites. All the keyboard characters except the upper case alphabet were redefined to create the images used in the program. With a specific plan in mind, it was simple to make the sprites execute as I had intended, and on that hot August weekend we created *Word World*.

Word World gives young people practice in writing the names of objects. Upon hitting the ENTER key, the object appears with color, motion, and sometimes with sound effects. There are two levels. In level one, the computer reads a word at random from a list of fourteen words in data. The word appears with the cursor immediately below it. When the user types the word, a musical sound verifies the correctness of the response. If the word is misspelled, a beep sounds, indicating the computer is ready for another try. For example, the computer displays the word "van." If the child types "van," The computer asks for "orange or blue." If the child enters "blue," a blue van accompanied by a siren sound appears and moves along a road.

In level two, the child inputs the words in any order. With experience, an entire scene can be created by typing a sequence of words. The user can change levels at any time by merely pressing REDO, then ENTER, after each beep for a new word. Similarly, the program can be stopped by hitting either the QUIT key or the Q key, then ENTER. After level one ("balloon" is always the last word of that level), there are three options: QUIT, REDO, or go back and change part of the existing scene.

My son prefers to enter words in any order that he chooses, but he does not yet know the spelling of all the words. As a result, we use level two and individual word cards. He requests cards as he wants them.

Many modifications are possible. By judicious editing (mainly deletion of lines), one can make a simpler version to display a sprite upon entering a single word. The same program structure could be used for other scenes. Line 770 is the key line in the program. It responds to input and causes a branch to a subroutine. If you change the landscape, redefine the characters for the sprites (lines 330-480), and change the subroutines, you will have a completely new program using this structure.

The sound routines for the engines, siren, chimes, and footsteps were programs published in *99'er* (Vol. 1, No. 6). The other sounds are variations of these routines. Adding sound, color, and motion seems to greatly increase the user's interest and involvement.

I hope that *99'er* readers will have as much fun with *Word World* as I have had writing and testing it.

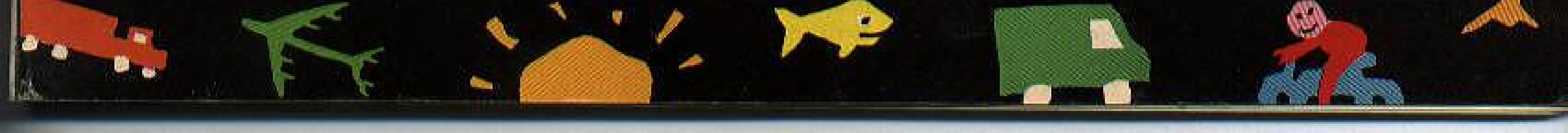
Notes: A red balloon deletes the moon and lower tree, while the moon deletes a red balloon. This is done because Extended BASIC allows only four visible sprites in a given row.

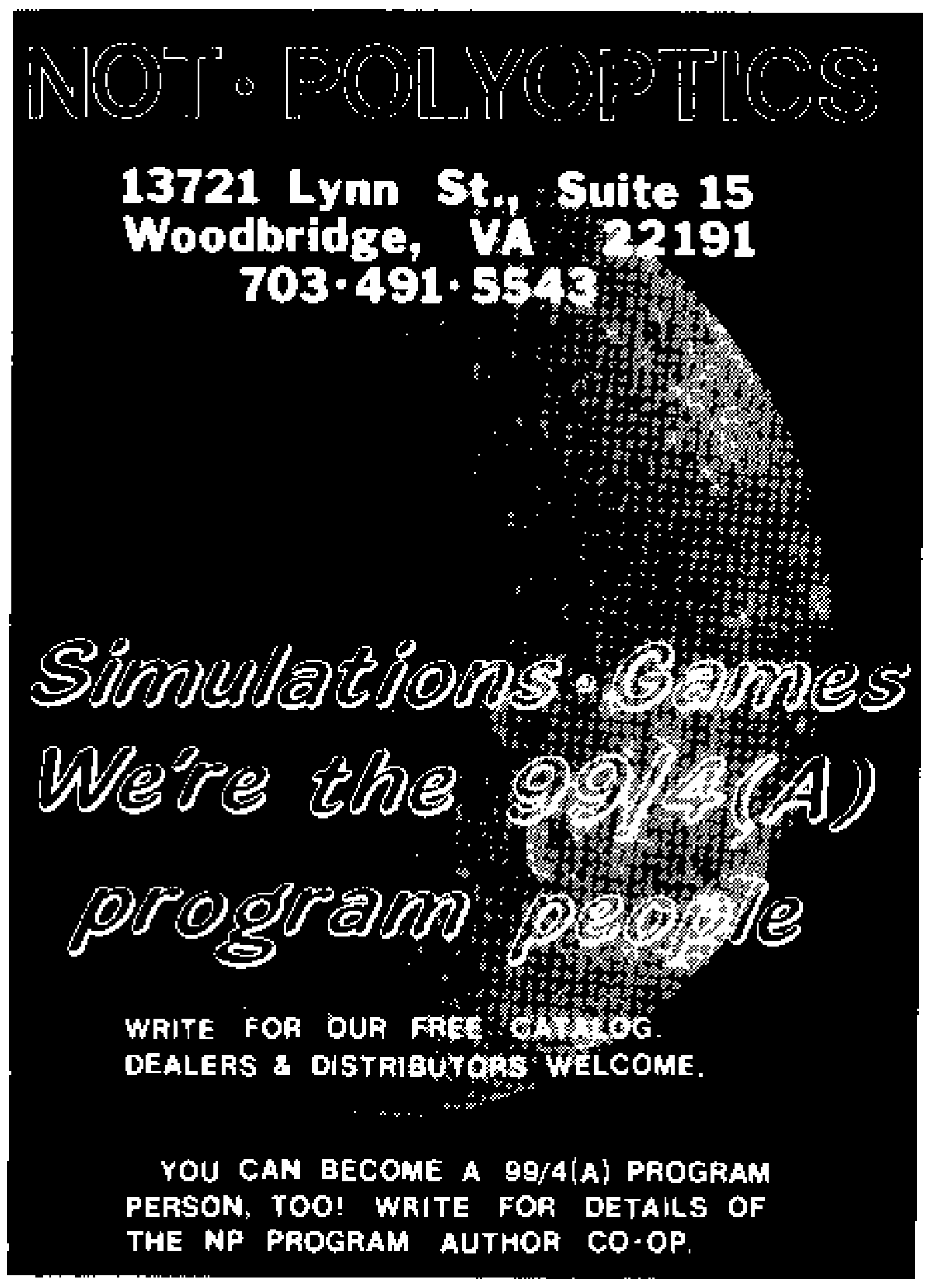
If you have an Extended BASIC cartridge that executes at a rate different from mine, you will need to adjust the plane's velocity in line *260* so that it is in phase with the vapor trail.

Continued on p. 66

EXPLANATION OF THE PROGRAM
Word World

Line Nos.	
180	Go to screen title routine.
190-260	Get sprites for title screens.
270-290	Request instructions and pick level.
300-480	Define characters for landscape and sprites.
490-550	Set up landscape.
560-660	Manage level one.
670-740	Manage level two.
750-770	Accept word and branch to subroutines for selected sprites.
780-840	House
850-990	Balloon
1000-1060	Car
1070-1130	Van
1140-1160	Sun
1170-1200	Moon
1210-1280	Truck
1290-1350	Boat
1360-1420	Plane
1430-1490	Jet
1500-1520	Tree
1530-1590	Motorcycle
1600-1710	Fish
1720-1860	Boy
1870-1920	Execute options for end of level one.
1930-2030	Siren sound.
2040-2130	Door chime sound.
2140-2260	Engine sound for car and truck.
2270-2400	Footstep sounds.
2410-2480	Plane noise.
2490-2560	Jet noise.
2570-2680	Motorcycle engine noise.
2690-2800	Title screen.
2810-2860	Display instructions.
2870-2890	Display options for begin and redo.
2900	Clear word and return to main program.





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WORD WORLD

```
100 REM ***************
110 REM * WORD WORLD *
120 REM ***************
130 REM
140 REM BY A.N. FALCO
150 REM 99'ER VERSION 2.6.1XB
160 REM
170 CALL CLEAR :: CALL MAGNIFY(4)
180 GOSUB 190 :: GOSUB 2690 :: GOT
    O 270
190 CALL CHAR(136,"0000000103070F1
    F3F7F7F0000FF7F3F0040C0C0E0E0E
    0E0E0E0E04040FFFEFC")
200 CALL CHAR(132,"00000000000307
    F7F3030000000000000E0E0E0E0E0E
    0F8F8E0E0E0E0E00000")
210 CALL CHAR(124,"0001000100804O3
    F3F40B0000100010000B0C0E030781
    8FFFF187830E0C08000")
220 CALL CHAR(120,"00000000000010
    7070F1F27494F2216000000000CFCF
    0F8DC88FCEA69FD321C")
230 CALL SPRITE(#20,136,4,155,20,0
    ,-24)
240 CALL SPRITE(#11,120,2,160,10,0
    ,25)
250 CALL SPRITE(#1,124,5,1,30,0,80
    )
260 R=20 :: CALL SPRITE(#3,132,7,R
    ,20,0,25):: RETURN
270 GOSUB 190 :: CALL DELSPRITE(AL
    L)
280 CALL CLEAR :: GOSUB 2850
290 CALL KEY(0,K,S):: IF ((FRAME<>
    2)AND(K>50 OR K<49))THEN 290 E
    LSE K=K+7 :: CALL CLEAR
300 DIM V(7),SEL$(14),SEL(14):: RA
    NDOMIZE
310 RESTORE 330 :: FOR CH=1 TO 16
    :: READ CH1,CH$ :: CALL CHAR(C
    H1,CH$):: NEXT CH
320 GOTO 490
330 DATA 100,01071F7FFF3F3F3131313
    931313171FF80E0F8FEFFFCFCCCCCC
    CFCFCFCFCFEFF
340 DATA 104,030F1F1F3F3F3F3F1F1F0
    F0300000000C0F0F8F8FCFCFCFCF8F
    8F0C080804020
350 DATA 108,00000000000000103063F7
    FFF1800000000000000000F80C0EF
    FFFFF0C
360 DATA 112,0000070F1931313F7FFFF
    FFFFF3030000000FEFFFFFFFFFFFFF
    FFFFFFFF0C0C
370 DATA 116,071F3F7F7FFFFFFFFFFFF
    F7F7F3F1F07E0F8FCFEFEFFFFFFFFF
    FFFFEFEFCF8E0
380 DATA 120,071F3E7C7CFCFCF8F8FCF
    C7C7C3E1F07C000000000000000000
    000000000080
390 DATA 124,0000000000000000FFFFFFF
    FFFFFA0000000000000000000C0DCF
    CDFFFFF12
400 DATA 128,000000103070F1F3F7F7
    F0000FF7F3F0040C0C0E0E0E0E0E0E
    0E04040FFFEFC
410 DATA 132,00000000000030307F7F303
    0000000000000E0E0E0E0E0E0F8F8E
    0E0E0E0E0E0
420 DATA 136,0001000100804O3F3F40B
    0000100010000B0C0E030781BFFFF1
    87830E0C080
430 DATA 36,00031C11E945FF62750D03
    010101010300606080DB0D7DCF38EBE
    F0B0B0B0B0C0
440 DATA 44,00000000000080C36F3F7FCF
    0700010000000000000000F8FCFEFE
    FEF8C080
450 DATA 48,0000000000003C77F3F3F
    3760800000000000000000E0FCFEFF
    FEF8
460 DATA 60,000000000000107070F1F
    27494F2216000000000CFCF0F8DC8B
    FCEA69FD321C
470 DATA 92,0103030103030303030303
    0303030303B0C0C0B0C0C0D0C0C0C0
    C0C0C0C0C0E0
480 DATA 96,0103030103070F1B1B0303
    03060C0C0EB0C0C0B0C0E0F0DCCCC0
    C0C060303038
490 CALL CLEAR :: CALL SCREEN(8)
500 CALL COLOR(2,5,15):: FOR X=5 T
    O 8 :: CALL COLOR(X,2,1):: NEX
    T X
510 CALL COLOR(4,4,2)
520 CALL CHAR(40,"00",41,"FFFFFFFF
    FFFFFFFF",42,"0103070F1F3F7FFF
    ",56,"00",57,"FFFFFFFFFFFFFFFF
    ")
530 CALL HCHAR(1,1,40,32):: CALL H
    CHAR(2,1,40,32):: CALL HCHAR(8
    ,1,57,64):: CALL HCHAR(10,1,56
    ,128)
540 CALL HCHAR(14,1,57,64):: CALL
    HCHAR(16,1,40,64):: CALL HCHAR
    (18,1,42,32):: CALL HCHAR(19,1
    ,41,64)
550 DISPLAY AT(24,3):"WORD WORLD"
560 IF K=57 THEN GOTO 670
570 IF W<>0 THEN 590
580 RESTORE 1870 :: FOR X=1 TO 13
    :: READ SEL$(X):: SEL(X)=0 ::
    NEXT X
590 IF W=15 THEN 1880
600 IF W=13 THEN A,W,PICTURE=14 ::
     SEL$(14)="BALLOON" :: GOTO 63
    0
610 A=INT(13*RND)+1
620 IF SEL(A)=1 THEN 610
630 DISPLAY AT(21,4):SEL$(A)
640 ACCEPT AT(22,4)VALIDATE(UALPHA
    ,"=","8")BEEP:PICK$ :: IF PICK
    $="8" THEN 680
650 IF (PICK$="=")OR(PICK$="Q")THE
    N CALL CLEAR :: STOP
660 IF PICK$=SEL$(A)THEN SEL(A)=1
    :: W=W+1 :: PICTURE=A :: GOTO
    750 :: ELSE GOTO 630
670 ACCEPT AT(21,4)VALIDATE(UALPHA
    ,"=","8")BEEP:PICK$ :: IF (PIC
    K$="Q")OR(PICK$="=")THEN CALL
    CLEAR :: STOP
680 IF PICK$="8" THEN K=56 :: FRAM
    E=1 :: W=0 :: ANS$="N" :: CALL
     CLEAR :: CALL DELSPRITE(ALL):
    : GOTO 280
690 RESTORE 1870
700 FOR N=1 TO 14
710 READ SEL$(N)
720 IF PICK$=SEL$(N)THEN PICTURE=N
     :: GOTO 750
730 NEXT N
740 GOTO 560
750 J=330 :: L=4*J/3 :: CALL SOUND
    (500,J,6,J*1.01,6,2*J,9):: CAL
    L SOUND(-750,L,6,L*1.01,6,880,
    9)
760 CALL SOUND(10,40000,30)
770 ON PICTURE GOTO 790,1010,1080,
    1150,1180,1220,1300,1370,1440,
    1510,1540,1610,1730,860
780 REM HOUSE
790 DISPLAY AT(21,4)BEEP:"RED OR Y
    ELLOW"
800 ACCEPT AT(22,4)VALIDATE(UALPHA
    )BEEP:HC$
810 IF HC$<>"RED" AND HC$<>"YELLOW
    " THEN 790
820 IF HC$="RED" THEN HC=9 :: GOTO
     830 ELSE HC=11
830 CALL SPRITE(#11,100,HC,38,152,
    #9,100,HC,103,48):: GOSUB 2050
840 GOTO 2900
850 REM BALLOON
860 DISPLAY AT(21,4)BEEP:"RED OR P
    URPLE"
870 ACCEPT AT(22,4)VALIDATE(UALPHA
    )BEEP:BC$
880 IF BC$<>"RED" AND BC$<>"PURPLE
    " THEN 860
890 IF BC$="PURPLE" THEN DISPLAY A
    T(21,4)BEEP:"LEFT OR RIGHT" ::
     BC=14
900 IF BC$="RED" THEN 940
910 ACCEPT AT(22,4)VALIDATE(UALPHA
    )BEEP:LR$ :: IF LR$<>"LEFT" AN
    D LR$<>"RIGHT" THEN 910
920 IF LR$="RIGHT" THEN BVH=20 ::
    BVV=0 :: GOTO 980
930 BVH=-20 :: BVV=0 :: GOTO 980
940 DISPLAY AT(21,4)BEEP:"UP OR DO
    WN"
950 ACCEPT AT(22,4)VALIDATE(UALPHA
    )BEEP:UD$ :: IF UD$<>"UP" AND
    UD$<>"DOWN" THEN 950
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WORD WORLD

```
960 IF UD$="UP" THEN BVV=-20 :: BV
    H=0 :: BC=7 :: GOTO 980
970 BVV=20 :: BVH=0 :: BC=7
980 CALL SPRITE(#2,104,BC,56,124,B
    VV,BVH)
990 GOTO 2900
1000 REM CAR
1010 DISPLAY AT(21,4)BEEP:"FORWARD
     OR BACKWARD"
1020 ACCEPT AT(22,4)VALIDATE(UALPHA
     )BEEP:CAR$
1030 IF CAR$<>"FORWARD" AND CAR$<>"
     BACKWARD" THEN 1010
1040 IF CAR$="FORWARD" THEN CAR=-20
      ELSE CAR=10
1050 CALL SPRITE(#12,108,8,77,2,0,C
     AR):: GOSUB 2150
1060 GOTO 2900
1070 REM VAN
1080 DISPLAY AT(21,4)BEEP:"ORANGE O
     R BLUE"
1090 ACCEPT AT(22,4)VALIDATE(UALPHA
     )BEEP:VAN$
1100 IF VAN$<>"BLUE" AND VAN$<>"ORA
     NGE" THEN 1080
1110 IF VAN$="BLUE" THEN VAN=6 ELSE
      VAN=10
1120 CALL SPRITE(#20,112,VAN,75,20,
     0,-24):: GOSUB 1940
1130 GOTO 2900
1140 REM SUN
1150 CALL SPRITE(#27,116,12,3,26)
1160 GOTO 2900
1170 REM MOON
1180 IF BC$="RED" THEN CALL DELSPRI
     TE(#2)
1190 CALL SPRITE(#26,120,16,1,208)
1200 GOTO 2900
1210 REM TRUCK
1220 DISPLAY AT(21,4)BEEP:"WHITE OR
      YELLOW"
1230 DISPLAY AT(22,4):"
        "
1240 ACCEPT AT(22,4)VALIDATE(UALPHA
     )BEEP:TRU$
1250 IF TRU$<>"WHITE" AND TRU$<>"YE
     LLOW" THEN 1220
1260 IF TRU$="WHITE" THEN TRU=16 EL
     SE TRU=12
1270 CALL SPRITE(#22,124,TRU,59,6,0
     ,25):: GOSUB 2150
1280 GOTO 2900
1290 REM BOAT
1300 DISPLAY AT(21,4)BEEP:"STAY OR
     SAIL"
1310 ACCEPT AT(22,4)VALIDATE(UALPHA
     )BEEP:BOA$
1320 IF BOA$<>"STAY" AND BOA$<>"SAI
     L" THEN 1300
1330 IF BOA$="SAIL" THEN BOA=-10 EL
     SE BOA=0
1340 CALL SPRITE(#4,128,16,122,190,
     0,BOA)
1350 GOTO 2900
1360 REM PLANE
1370 DISPLAY AT(21,4)BEEP:"FAST OR
     SLOW"
1380 ACCEPT AT(22,4)VALIDATE(UALPHA
     )BEEP:PLA$
1390 IF PLA$<>"FAST" AND PLA$<>"SLO
     W" THEN 1370
1400 IF PLA$="FAST" THEN PLA=90 ELS
     E PLA=50
1410 CALL SPRITE(#25,132,7,9,20,0,P
     LA):: GOSUB 2420
1420 GOTO 2900
1430 REM JET
1440 DISPLAY AT(21,4)BEEP:"FAST OR
     SLOW"
1450 ACCEPT AT(22,4)VALIDATE(UALPHA
     )BEEP:JET$
1460 IF JET$<>"FAST" AND JET$<>"SLO
     W" THEN 1440
1470 IF JET$="FAST" THEN JET=120 EL
     SE JET=80
1480 CALL SPRITE(#1,136,5,1,30,0,JE
     T):: GOSUB 2500
1490 GOTO 2900
1500 REM TREE
1510 CALL SPRITE(#5,36,13,104,76,#1
     4,36,13,38,124)
1520 GOTO 2900
1530 REM MOTORCYCLE
1540 DISPLAY AT(21,4)BEEP:"FAST OR
     SLOW"
1550 ACCEPT AT(22,4)VALIDATE(UALPHA
     )BEEP:MCY$
1560 IF MCY$<>"FAST" AND MCY$<>"SLO
     W" THEN 1540
1570 IF MCY$="FAST" THEN MCY=40 ::
     GOTO 1580 ELSE MCY=24
1580 CALL SPRITE(#3,60,2,41,10,0,MC
     Y):: GOSUB 2580
1590 GOTO 2900
1600 REM FISH
1610 DISPLAY AT(21,4)BEEP:"SWIM OR
     STAY"
1620 ACCEPT AT(22,4)VALIDATE(UALPHA
     )BEEP:FIS$
1630 IF FIS$<>"SWIM" AND FIS$<>"STA
     Y" THEN 1610
1640 IF FIS$="SWIM" THEN FIS=8 :: G
     OTO 1650 ELSE FIS=0
1650 M=0 :: CALL SPRITE(#6,44,8,130
     ,32)
1660 CALL MOTION(#6,0,FIS):: PAT=2
1670 CALL PATTERN(#6,46+PAT)
1680 PAT=-PAT :: M=M+1
1690 CALL POSITION(#6,ROW,COL)
1700 IF COL>248 OR M>100 THEN 2900
1710 GOTO 1670
1720 REM BOY
1730 DISPLAY AT(21,4)BEEP:"RUN OR W
     ALK"
1740 ACCEPT AT(22,4)VALIDATE(UALPHA
     )BEEP:BOY$
```

Continued on p. 68

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WORD WORLD . . . from p. 67

```
1750 IF BOY$<>"WALK" AND BOY$<>"RUN
     " THEN 1730
1760 IF BOY$="RUN" THEN BOY=20 ELSE
      BOY=4
1770 GOSUB 2280 :: CALL SPRITE(#10,
     92,7,90,10,0,BOY)
1780 PAT=2
1790 CALL PATTERN(#10,94+PAT)
1800 IF BOY$="WALK" THEN 1810 ELSE
     1820
1810 FOR DELAY=1 TO 5 :: NEXT DELAY
1820 PAT=-PAT
1830 CALL POSITION(#10,ROW,COL)
1840 IF COL>248 THEN 1850 ELSE 1790
1850 CALL PATTERN(#10,96)
1860 GOTO 2900
1870 DATA HOUSE,CAR,VAN,SUN,MOON,TR
     UCK,BOAT,PLANE,JET,TREE,MOTORC
     YCLE,FISH,BOY,BALLOON
1880 DISPLAY AT(21,4):"PRESS REDO B
     ACK OR QUIT"
1890 CALL KEY(0,K,S):: IF S=0 THEN
     1890
1900 IF K=56 THEN CALL DELSPRITE(AL
     L):: W=0 :: ANS$="N" :: FRAME=
     1 :: CALL CLEAR :: GOTO 280
1910 IF K=57 THEN DISPLAY AT(21,4):
     "" :: W=0 :: GOTO 670
1920 IF K=61 THEN CALL CLEAR :: END
      :: ELSE GOTO 1880
1930 REM SIREN SOUND
1940 N=1
1950 FOR F=700 TO 900 STEP 5
1960 CALL SOUND(-99,F,0)
1970 NEXT F
1980 FOR F=900 TO 700 STEP -8
1990 CALL SOUND(-99,F,0)
2000 NEXT F
2010 N=N+1
2020 IF N=4 THEN 2030 ELSE 1950
2030 RETURN
2040 REM DOOR CHIME
2050 FOR J=1 TO 3
2060 FOR A=0 TO 30 STEP 5
2070 CALL SOUND(-99,698,A,1924,A)
2080 NEXT A
2090 FOR A=0 TO 30 STEP 5
2100 CALL SOUND(-99,554,A,1527,A)
2110 NEXT A
2120 NEXT J
2130 RETURN
2140 REM ENGINE SOUND FOR CAR AND T
     RUCK
2150 FOR N=1 TO 8
2160 CALL SOUND(60,220,8,-5,0)
2170 CALL SOUND(60,220,8,-5,5)
2180 NEXT N
2190 CALL SOUND(80,220,8,-5,0)
2200 FOR F=1000 TO 4000 STEP 20
2210 CALL SOUND(-99,111,30,111,30,F
     ,30,-8,0)
2220 NEXT F
2230 FOR F=4000 TO 700 STEP -50
2240 CALL SOUND(-99,111,30,111,30,F
     ,30,-8,0)
2250 NEXT F
2260 RETURN
2270 REM FOOT STEPS
2280 IF BOY$="RUN" THEN J=.4 ELSE J
     =.8
2290 N=1
2300 X=INT(RND*5)
2310 IF X=2 THEN 2380
2320 CALL SOUND(5*J,-3,5)
2330 CALL SOUND(30*J,-7,20)
2340 CALL SOUND(500*J,-7,30)
2350 N=N+1
2360 IF BOY$="RUN" THEN IF N=30 THE
     N 2400 ELSE 2300
2370 IF N=10 THEN 2400 ELSE 2300
2380 CALL SOUND(60,-7,20)
2390 GOTO 2340
2400 RETURN
2410 REM PLANE NOISE
2420 FOR F=220 TO 880 STEP 10
2430 CALL SOUND(-99,222,30,333,20,F
     ,30,-4,0)
2440 NEXT F
2450 FOR F=1 TO 80
2460 CALL SOUND(-99,222,30,333,20,8
     88,30,-4,0)
2470 NEXT F
2480 RETURN
2490 REM JET SOUND
2500 FOR F=440 TO 1320 STEP 15 :: G
     =-6*INT(F/440)+24
2510 CALL SOUND(-99,888,30,110,0,F,
     G,-2,5)
2520 NEXT F
2530 FOR F=1 TO 50
2540 CALL SOUND(-99,888,30,110,0,88
     0,8,-2,5)
2550 NEXT F
2560 RETURN
2570 REM MOTORCYCLE SOUND
2580 FOR N=1 TO 4
2590 CALL SOUND(60,220,8,-5,0)
2600 CALL SOUND(60,220,8,-5,5)
2610 NEXT N
2620 FOR F=2000 TO 4000 STEP 30
2630 CALL SOUND(-99,111,30,111,30,F
     ,30,-8,0)
2640 NEXT F
2650 FOR F=1 TO 60
2660 CALL SOUND(-99,111,30,111,30,4
     000,30,-8,0)
2670 NEXT F
2680 RETURN
2690 CALL CLEAR :: CALL SCREEN(16):
     : RESTORE 2710 :: CALL COLOR(2
     ,2,8)
2700 FOR X=5 TO 8 :: CALL COLOR(X,2
     ,8):: NEXT X :: CALL COLOR(9,8
     ,1):: CALL CHAR(96,"7F7F7F7F7F
     7F7F00")
2710 DATA 96,96,96,96,96,96,87,69,7
     6,67,79,77,69,91,84,79,96,96,9
     6,96,96,96
2720 DATA 96,96,96,96,96,96,87,79,8
     2,68,91,87,79,82,76,68,96,96,9
     6,96,96,96
2730 DATA 96,96,96,96,96,96,42,42,4
     2,42,42,42,42,42,42,42,96,96,9
     6,96,96,96
2740 CALL CHAR(91,"0"):: FOR ROW=7
     TO 11 STEP 2 :: R=R+16 :: CALL
      LOCATE(#3,R,20):: CALL SOUND(
     1930,330,3,333,0)
2750 FOR COL=6 TO 27 :: READ A :: C
     ALL HCHAR(ROW,COL,A):: NEXT CO
     L :: NEXT ROW
2760 IF ROW>11 THEN CALL LOCATE(#3,
     15,20)
2770 RESTORE 2800 :: FOR A=0 TO 7 :
     : READ V(A):: NEXT A
2780 FOR DEL=1 TO 500 :: NEXT DEL :
     : FOR A=0 TO 7 :: Q=V(A):: CAL
     L SOUND(300,Q,8,2.0002*Q,4,3*Q
     ,0):: NEXT A
2790 CALL CLEAR :: CALL CHARSET ::
     RETURN
2800 DATA 262,294,330,349,392,440,4
     94,523
2810 IF FRAME=2 THEN CALL KEY(0,K,S
     ):: IF S=0 THEN 2810 :: GOSUB
     2850 ELSE 2820
2820 CALL KEY(0,K,S):: IF S=0 THEN
     2820 :: IF (FRAME=2)AND((K<49)
     OR(K>50))THEN 2820
2830 K=K+7
2840 CALL CLEAR :: RETURN
2850 CALL CLEAR :: CALL SCREEN(12):
     : FOR X=2 TO 8 :: CALL COLOR(X
     ,2,1):: NEXT X
2860 CALL CHAR(49,"000818080808081C
     "):: CALL CHAR(50,"003844040810
     207C"):: DISPLAY AT(9,8):"PRE
     SS 1 OR 2"
2870 DISPLAY AT(20,5):"TO RESTART I
     N ANY" :: DISPLAY AT(22,5):"LE
     VEL ENTER 8 IN PLACE"
2880 DISPLAY AT(24,5):"OF A NEW WOR
     D"
2890 RETURN
2900 DISPLAY AT(22,4):"" :: GOTO 56
     0
```

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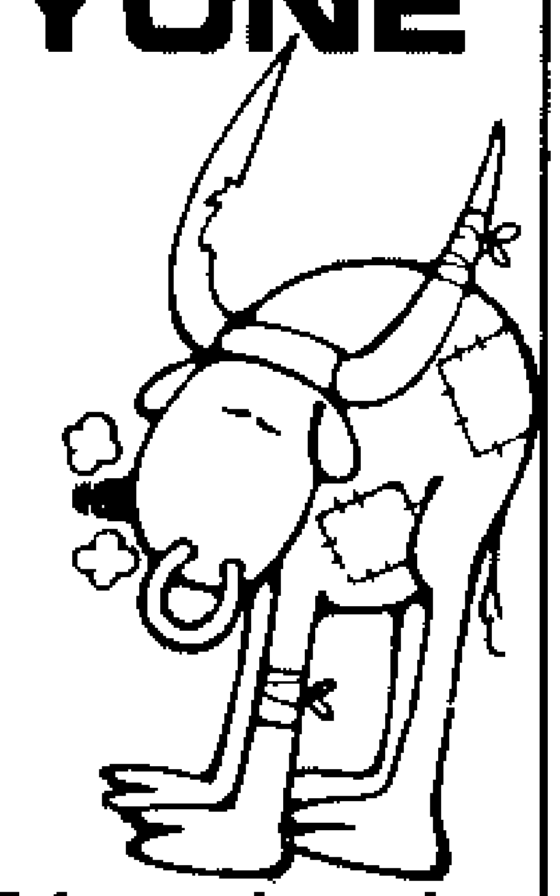

PROGRAMMING SPRITES . . . from p. 64

Earlier in this article, I mentioned that one of the things I wanted to demonstrate was the processor's speed. I really got a good demonstration of that while working on this section of the program. I started out loading the loop register with a value of a few hundred. I couldn't even discern a pause. I upped the value to a few thousand and began to see a very brief delay. In the final version presented here, I have loaded the maximum value which the register will hold. When you run the program, you will see that the pause is still very brief. The logic here will be reused for the pause after the sprites all reach the right edge of the screen. The code segment for the pause is in Part 11.

Step 5

Peel off the first sprite by moving it to the right edge of the screen. Then do the same for the rest of the sprites in turn. Pause, and then go back to step 2 to perform the demonstration again.

We don't have to do anything special to get the peeling effect; the computer will take care of that. All we need to do is set the sprites in motion again one by one. We've already seen that we can use the code presented above to move the sprites this way. We need only set the X-coordinate to be tested against (in register 8) to 232 for this situation.

Since we are using the code in sections 3 and 4 for movements both toward and away from the center, the system will have to decide which case is in effect when it gets to this final section of code. If the sprites are at the center of the screen, then the system should start the peel-off process. If the sprites are at the right edge of the screen, the system should go back to label L1 in step 2 to start the demonstration over. One way for the system to discriminate between these cases is to look at register 8. Register 8 is set by our program, and it contains 124 if the sprites are in the middle of the screen or 232 if the sprites are at the right edge. Thus we can test register 8 for any value above 124 (and below 232) to tell if we are at the right side of the screen. I've used 125; you might want to use something different for fun, say 200.

The final code segment is in Part 12. This is the end of the program itself. We have to do one more thing before we END the program: namely, put an entry in the DEF/REF table so that our program can be RUN by name (we'll call it SPRITE). The DEF/REF table resides at the end of the Mini Memory. It already contains entries for OLD and NEW (used with the Line-by-Line Assembler) which we don't want to wipe out. The first free spot before those entry points is at location >7FE8, so we'll put our entry point there. Each DEF/REF table entry consists of a six-character name (SPRITE in our case) and the address of the first line of the program logic (not the data). When you enter the sprite program, your data will start at >7D00. If you watch the location counter as you go, you'll see that the first program logic statement (LWPI) falls at address >7D5C; this is our entry point.

To make the DEF/REF table entry, enter the code from Part 13.

I can't help but wonder how many of you are thinking, "All that just to move five sprites across the screen?" Of course, there are many more exciting things you can do with sprites. I hope this article will help you get started.

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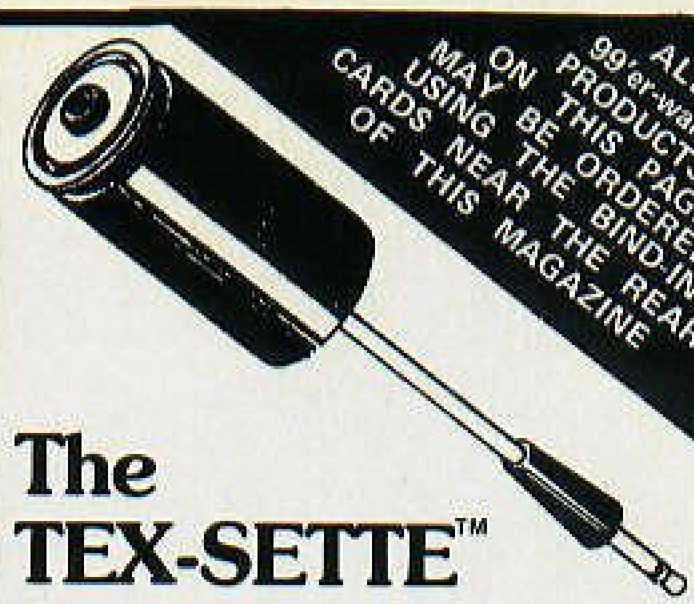

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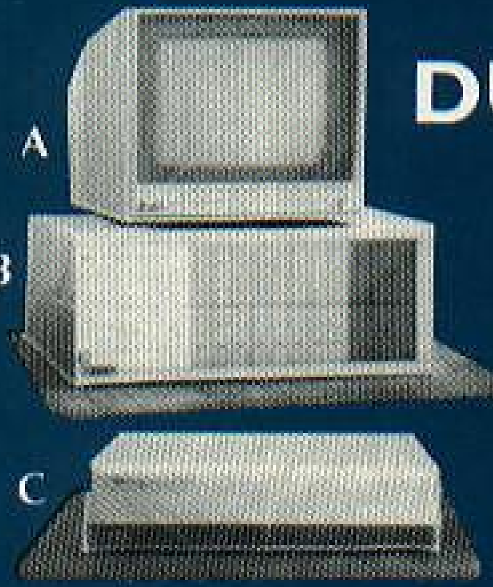

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